United States Department of the Interior

TAKE PRIDE IN AMERICA

NATIONAL PARK SERVICE
P.O. BOX 37127
WASHINGTON, D.C. 20013-7127

IN REPLY REFER TO:
H1817(408)

4 DEC 1990

Memorandum

To: Directorate and Field Directorate

From: Director JMRidenour

Subject: Issuance of the Museum Handbook, Part I, Museum Collections

Attached please find a copy of the NPS Museum Handbook, Part I, Museum Collections. This document provides state-of-the-art guidance on scope of collections, handling objects, environmental monitoring and control, museum pest management, museum collections storage, packing and shipping, conservation treatment, museum security and fire protection, emergency planning, curatorial health and safety, planning and programming for museum collections management, and museum ethics. The subject document replaces Museum Handbook, Part I, Museum Collections, issued to the field in 1967 and 1969, and supersedes related chapters in Manual for Museums (1976). The old Part I should be marked as out-of-date and retained solely as a record of past guidance.

This document represents the culmination of several years work by the NPS Museum Handbook Steering Committee, numerous authors, both inside and outside the National Park Service, and the Curatorial Services Division, WASO. An important feature of this document is the set of technical appendices that address the care and preservation of archeological collections, paintings, and cellulose nitrate negatives, and objects made of paper, textile, wood, metal, ceramic, glass, and stone. Work is underway on preparation of additional technical appendices that will address the care of natural history collections, photographic collections, and leather and skin objects. We did not want to delay issuance of Part I while waiting for their completion. Hence, they will be issued for insertion in 1991.

The revised Museum Handbook, Part I, Museum Collections, is the second of a series of revisions to the NPS Museum Handbook. The Museum Handbook, Part II, Museum Records (Revised 1984), is currently being updated and revisions will be issued for review in 1991. Work will begin in 1991 to revise the Museum Handbook, Part III, Furnished Historic Structure Museums (issued in 1968 and 1969), and Part IV, Exhibit Maintenance and Replacement (issued in 1968). Both of these parts will be combined in a revised Part III that will address the use of museum collections.

We are planning to make Part I of the Museum Handbook available for purchase to non-NPS users. The Superintendent of Documents, U.S. Government Printing Office has agreed to sell the handbook in its bookstores.

Attachment

MUSEUM HANDBOOK

PART I

MUSEUM COLLECTIONS

REVISED

SEPTEMBER 1990

United States Department of the Interior

NATIONAL PARK SERVICE
P.O. BOX 37127
WASHINGTON, D.C. 20013-7127

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

To: Associate Director, Cultural Resources, WASO-400
Attention: Chief Curator-408

Through: Regional Director

From:

Date:

Subject: Comments on Museum Handbook, Part I, Museum Collections

Comments on the revised Museum Handbook are welcome. Park staff are asked to fill in staff name, title and park, and submit comments, through the regional office, to the Associate Director, Cultural Resources, WASO, Attention: Chief Curator. The comments will be considered in the next revision.

TABLE OF CONTENTS

5. BIOLOGICAL INFESTATIONS

6. HANDLING, PACKING AND SHIPPING MUSEUM OBJECTS

7. MUSEUM COLLECTIONS STORAGE

8. MUSEUM OBJECT CONSERVATION TREATMENT

9. MUSEUM COLLECTIONS PROTECTION: SECURITY AND FIRE PROTECTION

10. MUSEUM COLLECTIONS: EMERGENCY PLANNING

11. CURATORIAL HEALTH AND SAFETY ISSUES

12. CURATORIAL PROGRAMMING, FUNDING, AND STAFFING

APPENDICES

P. CURATORIAL CARE OF CERAMIC, GLASS, AND STONE OBJECTS

Q. CURATORIAL CARE OF NATURAL HISTORY COLLECTIONS
(To be released at a future date)

R. CURATORIAL CARE OF PHOTOGRAPHS
(To be released at a future date)

S. CURATORIAL CARE OF LEATHER AND SKIN OBJECTS
(To be released at a future date)

LIST OF FIGURES

INTRODUCTION

The Museum Handbook covers a myriad of topics to guide National Park Service curatorial staff in managing museum collections. In Part I all disciplines and materials represented by NPS collections are covered as well as professional ethics and a variety of circumstances from specialized storage, to exhibit environment standards, to conservation treatments, to emergency preparedness. In Part II the standard procedures for museum record keeping, including accessioning, cataloging, loans, and photography, as well as recording losses and reporting annual collection management data are given. Part III, to be issued in 1992-93, will provide guidance on the curatorial standards to be maintained when collections are used for exhibits, interpretation, and research. It will also provide guidance on the care of collections requiring specialized attention, such as sensitive and sacred Native American objects.

In spite of the extensive and detailed information provided, the Museum Handbook cannot be considered a stand-alone prescription for action. The expertise and judgment of the curatorial staff and others, such as conservators, who may be called upon for advice, are the most essential ingredients to effective preservation and management of the collections. Those individuals making collection management decisions will need to consult the Museum Handbook, draw on their own knowledge and that of specialists, seek additional information in the references listed in each chapter of the Museum Handbook and, as appropriate, request advice or technical assistance from preservation centers or regional and Washington offices. Diligent use of these sources and reasoned decision-making by adequately trained staff should ensure that the National Park Service collections will be, as mandated by the 1916 NPS Organic Act, preserved and maintained for the use and enjoyment of future generations.

Ann Hitchcock
Chief Curator
Washington Office
September 1990

ACKNOWLEDGEMENTS

The preparation of the NPS Museum Handbook, Part I, has been coordinated by the Curatorial Services Division, Washington, D.C. Support in providing technical information and in writing chapters or sections of chapters has come from curatorial staff in the Curatorial Services Division, parks and regional offices and from conservators at Harpers Ferry Center and in regional offices. Conservators from the Smithsonian Institution and the National Gallery of Art also contributed to the handbook.

Members of the NPS Museum Handbook Steering Committee who coordinated the writing of the topics include: John Clonts, Handbook Committee Chairman and Chief, Museum Collections Repository, Western Archeological and Conservation Center; Tom Carter, Conservator, Harpers Ferry Center; Lynne Leopold-Sharp, Museum Curator at Minuteman NHP; John Hunter, Regional Curator, Midwest Region; Ellen Seeley, Curator, Glacier National Park; Bill Gregg, National Park Service Man and Biosphere Coordinator, Washington Office; and Ann Hitchcock, Chief Curator, Washington Office.

The authors include:

Chapter 1 - John Clonts; Lynne Leopold-Sharp; Ellen Seeley; Bill Gregg; David Brugge, Regional Curator, Southwest Regional Office; Dan Chure, Paleontologist/Curator, Dinosaur National Monument; Wayne Hamilton, Geologist, Yellowstone National Park; Kim Sikoryak, Interpreter, John Day Fossil Beds National Monument; David Nathanson, Chief, Office of Library Services, Harpers Ferry Center; Mimi Bowling, Archivist, Edison National Historic Site; Ann Hitchcock; and Ralph Lewis, Volunteer-in-Park, Curatorial Services Division

Chapter 2 - Tony Knapp, Staff Curator, Curatorial Services Division; Debra Berke, Staff Curator, Curatorial Services Division; and Bill Jedlick, Regional Curator, Mid-Atlantic Region

Chapter 3 - Tony Knapp

Chapter 4 - Edward McManus, Regional Conservator, North Atlantic Region; Tom Carter; Diana Pardue, Staff Curator, Curatorial Services Division; John Hunter; and Toby Raphael, Conservator, Harpers Ferry Center

Chapter 5 - Wendy Jessup, Collections Coordinator, Museum Support Center, Smithsonian Institution

Chapter 6 - Kathleen Byrne, Staff Curator, Curatorial Services Division; and Debra Berke

Chapter 7 - Donald Cumberland, Museum Specialist, Curatorial Services Division; Tony Knapp

Chapter 8 - Tom Carter; Tony Knapp; Dan Riss, Conservator, Harpers Ferry Center; Al Levitan, Conservator, Harpers Ferry Center

Chapter 9 - Tony Knapp and John Hunter

Chapter 10 - John Hunter

Chapter 11 - Tony Knapp; Bill Meuse, Museum Curator, Springfield Armory NHS; Bart Rogers, Metals Conservator, Harpers Ferry Center

Chapter 12 - Tony Knapp

Appendices A, C through F, and H - Tony Knapp

Appendix B - Ann Hitchcock

Appendix G - John Hunter, Supervisory Staff Curator, Curatorial Services Division, Harpers Ferry Office

Appendix I - Brigid Sullivan, Regional Conservator, Midwest Region

Appendix J - Jerri Newman, Paper Conservator, Frederick Law Olmsted NHS; Elizabeth Banks, Museum Curator, Frederick Law Olmsted NHS; and Anne Jordan, Staff Curator, Curatorial Services Division

Appendix K - Mary Ashton, Textiles Conservator, National Gallery of Art, Washington, D.C.

Appendix L - Tom Carter, Paintings Conservator, Harpers Ferry Center

Appendix M - John Maounis, Regional Curator, North Atlantic Region

Appendix N - Al Levitan, Furniture Conservator, Harpers Ferry Center

Appendix O - Edward McManus, Metals Conservator, National Air and Space Museum, Smithsonian Institution

Appendix P - Shelley Sturman, Objects Conservator and Judy Ozone, Objects Conservator, National Gallery of Art, Washington, D. C.

Thanks to Kent Bush, Regional Curator, Pacific Northwest Region and to Diane Nicholson, Regional Curator, Western Region for providing technical information and guidance on Chapter 12; to Connie Kurtz, Industrial Hygienist, Engineering and Safety Services Division, Washington Office, for providing technical information on Chapter 11; and to Gary Johnston, Service IPM Program Coordinator, Washington Office, for assistance with Chapter 5.

A special note of thanks to Carolyn Moler, Secretary, Curatorial Services Division, for the many hours devoted to typing and revising the handbook manuscript. The major credit, however, goes to Tony Knapp, Staff Curator, Curatorial Services Division who coordinated the entire project as well as writing several chapters and appendices.

A special note of appreciation to Vince Wilcox, Director, Museum Support Center, Smithsonian Institution; Ross Merrill, Chief, Department of Conservation, National Gallery of Art, Washington, D. C.; and Lynn Ezell, Collections Manager, National Air and Space Museum, Smithsonian Institution for supporting this project by providing staff to write the above mentioned chapter and technical appendices.

CHAPTER 1. NATIONAL PARK SERVICE MUSEUMS AND COLLECTIONS

A. PURPOSE OF NATIONAL PARK SERVICE MUSEUMS

In 1895, George Brown Goode defined a museum as "an institution for the preservation of those objects which best illustrate the phenomena of nature and the works of man, and the utilization of these for the increase in knowledge of the people." The American Association of Museums further defines a museum as "an organized and permanent non-profit institution, essentially educational or aesthetic in purpose, with professional staff, which owns and utilizes tangible objects, cares for them, and exhibits them to the public on some regular schedule." Both of these definitions contain important qualifiers that distinguish museums from exhibit galleries or curio collections. All museums share certain critical responsibilities.

Primary responsibilities, common to all museums, consist of the collection, preservation, study and interpretation of objects in perpetuity. Successful attainment of each of these tasks involves professional standards and duties to ensure that these obligations are fulfilled.

The collection is central to any museum. Museums serve as repositories for objects that document natural and cultural properties. The collection should have a defined scope, a specific written policy outlining what the museum will and will not collect. The objects, whether cultural or natural history, are inherently valuable for the information that they provide about processes, events, and interactions among cultures, individuals, and the environment. Placing objects within a broader context, through research, analysis and documentary records, provides for the greatest enjoyment and benefit by the public.

All museums accept certain responsibilities toward their collections. The first obligation is to **collect**, gathering objects of interest and importance within the scope of the institution. The collection is the foundation of the museum, and collecting is the activity around which all other functions revolve. The collection is also a non-renewable resource, impossible to replace once destroyed. Thus, the second obligation is to **preserve** the collection. Preservation ensures that the collection can continue in use and enjoyment into the future. The value of museum specimens is lost or substantially reduced if they, or data inherent in them, are altered; therefore, objects must be kept intact and in a condition as close to their original state as possible. Preservation allows the third and final obligation, **interpretation**, to proceed with confidence. Interpretation includes research and presentation. Active research realizes the collection's potential as a learning tool. In addition, study of the objects has a direct positive impact on presentation. Presentation includes museum exhibits, room settings in historic structures, and use of objects in other interpretive programs. Investigation into the history and use of the object or specimen allows it to be displayed within the context in which it was originally used. The educational and interpretive aspects of the collection must be realized and fulfilled. Exhibits encourage visitors to explore the ways individuals and societies perceive themselves and the world in which they live. Displayed in context, the object or specimen communicates

information and concepts, and helps to demonstrate the reality of lifeways in the past.

From the beginning National Parks have been established to conserve the diverse natural and cultural resources within them for the enjoyment of present and future generations. The National Park Service's mission, eloquently stated in the Organic Act of 1916, establishes the mission and function of museums in parks. To conserve an object, a park museum provides a safe repository to properly protect and preserve it. To provide for an object's enjoyment the park museum makes it available for use in the research and interpretive programs of the park.

Service museums care for objects and specimens that constitute the **prima facie** evidence of historical and natural events in those areas comprising the National Park System. Each park is, in effect, a museum in its totality. By Congressional declaration these areas are invaluable cornerstones of our American heritage. In a sense, each park's collection is a museum within a museum. Park museums are a unique resource enabling park staff to understand and appreciate the area they manage. The intimate association with specific park themes, and the on-site origin of many objects make NPS museum collections uniquely valuable resources.

An important use of the collection is in interpretive exhibits and other educational programs. Objects give the public an orientation to the park's scope and holdings. They also provide people an opportunity to directly associate with processes and events in the park, whether that be a way of life as seen in historic house furnishings or a way of death seen in the fossils produced by geologic events. Exhibits graphically demonstrate the extent of the nation's natural and cultural heritage preserved in the parks.

Another use of the park collections is by researchers. The natural and cultural materials function as a baseline database, serving as scientific and historical documentation of the resources of the area and of the purposes for which the parks were established. Cultural collections, objects and archival materials, may document important events or people in our history, technological processes or artistic endeavors.

National Park Service museums possess certain characteristics that distinguish them from other museums. Park museums and collections are relatively unique within the museum world. One significant difference between most park museums and other museums is that park museums are site-specific. The vast majority of holdings are derived either from within the park boundaries or from areas intimately associated with parks.

Another difference between Service museums and most other museums is the duality between the park museums themselves and what can be called the National Park Service Museum System. Park museums are the site- specific museums concerned with the collections of individual parks. Each is part of a greater system that sets policies and standards and guides their operation. No other museum network is so varied and dispersed, yet so administratively bound as a unit. The National Park Service Museum System provides a representative cross-section of the entire natural and cultural

heritage of the country. Thus, the scope of the system is necessarily wider than that of most public or private institutions. Park museums are units in a larger interpretive program. Each museum tells the story of its area, but is also part of a larger story which embraces the whole nation.

National Parks may be viewed, in one sense, as living museums. The park museum serves as one of the explanatory labels within the greater museum of the entire park. It exists to support the mission of the park by providing a safe repository for examples of the natural environment and manufactured objects associated with persons, places, events or activities commemorated by the park. Museum objects comprise a part of the park story and their collection is basic to each park's interpretive and resource management programs. Park and center managers and their staffs fulfill the role of museum administrators, research and security staff, exhibit development and design personnel, educators, curators and registrars. Preservation and care of the collections is a primary responsibility of all Park Service personnel.

B. HISTORY OF NATIONAL PARK SERVICE MUSEUMS

Even before 1916, park managers learned the value of museums. If they were to succeed in protecting natural or cultural objects that could not safely remain exposed in place, they would have to collect and care for them. Visitors found the collected objects helpful in understanding the parks. Reasoning along these lines, the acting superintendent of Yosemite National Park established an arboretum in 1904 to help preserve and interpret the park's trees and flowers. At the same time Frank Pinkley, the lone custodian of what would become Casa Grande National Monument, placed a small collection of archeological artifacts from the site on exhibit in the principal ruin. These spontaneous efforts to establish museums were followed by many others, as park after park began museum development on its own initiative.

Beginnings of Service Museums

In his letter of May 13, 1918, to Director Stephen T. Mather, Secretary of the Interior Franklin K. Lane set guidelines for the new Service. Not surprisingly he included, "Museums containing specimens of wild flowers, shrubs, and trees, and mounted animals, birds, and fish native to the parks, and other exhibits of this character, will be established as authorized". In his 1920 Annual Report to the Secretary, Director Mather made the following statement: "One of the most important matters to receive earnest consideration is the early establishment of adequate museums in every one of our parks."

In 1918, one of the first museums built and operated by the Service was opened in Mesa Verde National Park. Prior to the establishment of the park in 1906, many artifacts had been removed from sites located within present park boundaries. Artifacts recovered during park ruins stabilization and archeological research projects conducted before 1923 were placed in the Smithsonian Institution. Efforts to assemble a museum collection within the park began in 1917 when one room of a log cabin, built in 1916 as a ranger station, was converted into a museum. Service financial support for this project consisted of $22.00 for construction of an exhibit case. In 1921, Superintendent Jesse L. Nusbaum began an effort to replace the log cabin museum by building a large archeological museum on Chapin Mesa. His requests for service appropriations were repeatedly denied. He finally enlisted the support of private citizens. Donations from Stella Leviston of San Francisco, and from John D. Rockefeller, Jr., provided the financial support needed to build the museum and to purchase exhibit cases. The Mesa Verde Archeological Museum was opened to the public in 1925.

Development of NPS Museums

1924-1932

In 1924, Chauncey J. Hamlin, a private citizen of independent means, became acquainted with Yosemite's need for an adequate museum. As president of the American Association of Museums (AAM) in 1923, Hamlin had an opportunity to seek support for the proposed museum from the Laura

Spelman Rockefeller Memorial. He established an AAM Committee on Museums in National Parks to build and equip a museum for Yosemite. Dr. Hermon Carey Bumpus, a member of this committee, closely guided the Yosemite project to completion in 1926.

Dr. Bumpus, whose credentials included the first directorship of the American Museum of Natural History and the first presidency of the AAM, shaped the project to create a prototype park headquarters museum. The main floor of concrete and granite provided fire-safe housing for Yosemite's growing collections. A series of exhibit rooms interpreted, in turn, the significant geological, biological and human aspects of the park. An upper floor of wood contained offices, workrooms and meeting rooms for the park naturalist and his staff. The building, a well designed park landmark, still serves important curatorial and interpretive functions.

In 1926, the AAM received a second grant from the Memorial. This one provided $20,000 to create two smaller museums, one located in Grand Canyon National Park and the other in Bear Mountain State Park in New York. Committee member John C. Merriam, eminent paleontologist and president of the Carnegie Institution of Washington, accepted responsibilty for the Grand Canyon project. He set a standard for interpreting national parks by focusing on the features that justified establishment of the park. The museum, he determined, should enable visitors to understand the significance of those features as much as possible.

The Memorial gave the AAM a third and final grant in 1928, providing $112,000 for museums in Yellowstone National Park. Bumpus broadened the park museum experiment by proposing a chain of small trailside or focal-point museums. He placed these modest structures at thoughtfully chosen sites where each would introduce visitors to the significant aspects of the immediate vicinity: the Old Faithful Museum concentrated on geysers; the Madison Junction Museum overlooked the site of the legendary campfire around which some of Yellowstone's explorers voiced the national park idea, leading to creation of the park; and the museum at Norris Geyser Basin interpreted geothermal manifestations and the natural history of adjacent habitats. Still striving to label the major features of the park, which he considered the principal museum exhibits, Bumpus also conceived the idea of isolated wayside exhibits at strategic spots along park roads as supplements to the focal-point museums.

The projects funded by the Laura Spelman Rockefeller Memorial demonstrated the potential of such museums in preserving and interpreting park resources. Bumpus foresaw a further question concerning the viability of park museums: could National Park Service staffs maintain and operate them at professional standards? During development of the Yosemite and Yellowstone museums, park naturalist Carl P. Russell had done much of the actual exhibit planning and installation. In 1929 Russell was promoted to the new position of field naturalist-museum adviser. In this capacity he worked out of the Service's field Division of Education under Chief Naturalist Ansel Hall at Berkeley, California.

1933-1945

Beginning in 1933, emergency relief agencies, established in response to the country's economic depression, made unanticipated manpower and money available to the National Park Service. Through 1934, Carl Russell struggled to get exhibit plans produced so the new museums would measure up to the standards Bumpus and Merriam had set. Assisted by well-documented plans, an emergency staff in Berkeley prepared many of the needed exhibits. The division also used the workers to produce a variety of products useful in park interpretive operations, ranging from museum specimen storage cabinets and workshop furniture to pamphlet boxes and hand-colored lantern slides.

Early in 1935, Carl Russell was called to Washington to establish a new Eastern Museum Division and to recruit a temporary staff of curators, artists and craftsmen. Ned J. Burns was chosen to head the laboratory and to build the exhibits.

In 1935 park museums gained a wider and more specific legal basis. The Historic Sites Act signed into law that year empowered the Service to establish and maintain museums in connection with the preservation of sites, buildings, and objects of national historical or archeological significance. At the end of 1935 the Director made Russell chief of a new Servicewide museum division, called the Branch of Museums after World War II. Russell, however, provided first hand leadership to the consolidated organization for only about six months. In mid-1936 the Service needed his talents for other urgent assignments. Ned Burns replaced him as division chief. Burns continued to head the museum program until his death in 1953.

In 1940, Morristown National Historical Park replaced the temporary position held by its museum curator with a permanant one. Thus, J. Paul Hudson became perhaps the first Civil Service park museum curator. Park museums continued vigorous development under emergency funding until the beginning of World War II. At that time, attention shifted to establishing standards for the operation of Park Service museums. With strong support from Dr. Russell, Ned Burns prepared the National Park Service <u>Field Manual for Museums</u>, which was published by the Government Printing Office in 1941. Intended as a guide to park museum development and operation, the manual won the Service a leadership role among museums far beyond the parks.

1946-1973

World War II had caused a virtual halt in park museum growth. Only minimum staffs in parks and the central office were available to protect and interpret museum resources during the war years. After the war, development slowly resumed. The museum laboratory in Washington, D.C. reopened late in 1946 with an initial staff of two. Permanent positions were gradually added as the work grew. Recognizing the need for staff trained in scientific methods of preserving museum objects, the Branch of Museums hired its first conservator in 1950. She was Elizabeth Jones, a paintings conservator from the Fogg Art Museum at Harvard

University. She established a minimally equipped laboratory and began an NPS program for the treatment of museum objects. The Branch of Museums continued to build a small staff of specialists in preserving various types of museum objects. In 1950, Harold L. Peterson, who had been hired as a Service Curator in 1947, helped to establish a conservation laboratory at Colonial NHP for the proper treatment of objects generated by archeological research. In 1953, Ralph Lewis, who had served as Ned Burn's assistant, became the Chief of the Branch of Museums.

During the early 1950's, the question of legal authority to acquire, preserve and dispose of museum objects was addressed as a result of past situations where the Service's authority to carry out common museum practices was lacking or unclear. In 1955 the Management of Museum Properties Act was passed. This act authorized the Secretary of the Interior to accept donations of objects, purchase objects from donated funds, and loan or exchange objects. Concern within the Branch about unscholarly practices in furnishing historic structures for exhibition also resulted in the first formal historic furnishings plan.

As museum collections grew in size and value, the National Park Service increasingly recognized its accountability for them. Although pre-war forms and guidelines existed for systematically recording these collections, parks varied in the manner and extent to which they applied recommended procedures. Years of understaffing had caused a backlog of uncataloged museum objects. In 1957 two measures were taken to correct this situation. The Service issued a <u>Museum Records Handbook</u>, that described in detail revised forms and regulations. At the same time the Branch was directed to lead a specially funded crash program to bring all museum records up to date within three years. Vera Craig from Morristown NHP became staff curator to oversee this program. The Northeast, Southeast, Midwest, and Southwest regions appointed regional curators to assist and instruct the parks in carrying out this program. In 1959, the size of the NPS museum collection was estimated to be 2-1/2 million objects. By 1960 most parks reported their museum records complete. The regional curators were retained and assigned added duties. The remaining regions also hired regional curators as the need for their services became apparent.

Mission 66, launched in 1956, involved the Branch of Museums in the planning and preparing of exhibits for about 10 new museums a year for the next 10 years. These and many accompanying developments were needed to cope with great increase in public use. The Eastern Laboratory expanded its staff while the Western Laboratory was reactivated. John W. Jenkins, who had headed the museum of the State Historical Society of Wisconsin, ably directed the Western Laboratory until his death, after which Floyd A. Lafayette succeeded him.

The Conference of Regional Museum Curators, held in 1959, discussed the need for a clearinghouse to facilitate the exchange of museum objects among parks as authorized by the Management of Museum Properties Act of 1955. The conference participants recommended procedures that involved the exchange of lists of excess objects with the regional curator

facilitating most of the paperwork. They recommended that objects be transferred directly from park to park without passing through a central repository.

In 1964, the Branch of Museums was re-organized into the Branch of Museum Development and the Branch of Museum Operations. The Branch of Museum Development carried on the planning and preparation of exhibits. In step with changing times it turned preparations of exhibits in narrative series to installations using a much wider variety of design and encouraging access to individual exhibits at random. In 1966, a clearinghouse repository was established in Springfield, Virginia, to dispose of museum objects that were too large or bulky to be accommodated in park units. The Branch of Museum Operations, working with the regional curators, produced a Museum Handbook to guide parks staffs in all phases of operating and managing their museums. Part I of the handbook, Museum Collections was issued in 1967. The Museum Records Handbook, already in use, became Part II. Part III of the handbook, Furnished Historic Structure Museums, and Part IV of the handbook, Exhibit Maintenance and Replacement, were issued in 1968. In 1972, the Branch upgraded its program to provide parks with curatorial supplies and technical information on museum equipment.

1974-1979

In 1974, the Branch of Museum Operations became the Division of Museum Services. The Historic Furnishings function became part of a new Division of Reference Services, later achieving independent status as the Division of Historic Furnishings, Harpers Ferry Center. The Division of Museum Services staff advocated collection management and care, and built up the staff and facilities of the conservation laboratories. In 1975, the first Collection Management Plan was prepared by an NPS curatorial team for Hubbell Trading Post. In 1976, essential curatorial guidelines were made more accessible to the non-NPS museum community when a version of the NPS Museum Handbook, prepared by Ralph H. Lewis, was published under the title Manual for Museums. The Conserve O Gram series was initiated to provide technical guidance on the care of museum objects. During this period, the National Catalog of Museum Objects was established to centrally archive museum catalog records. The size of the NPS museum collection was estimated to be 10 million objects, of which 65% were archeological, 22% were historical, 1% were ethnological, 2% were natural history, and 10% were unclassified.

During the late 1970s, the Service became convinced that the problems of park museums and collections required direct representation in the Washington Office. This decision significantly influenced future directions of the Servicewide curatorial program. The passage of the Archeological Resources Protection Act of 1979 led to a significant increase in the scope and size of park museum collections. This Act included the following provision: "Archeological resources excavated or removed from public lands remain the property of the United States."

1980-1987

In 1980, the Director appointed a Chief Curator under the Assistant Director, Cultural Resources, Washington Office. During the early 1980's central leadership and support services for the NPS museum program dovetailed with an equally vital growth in the numbers and competence of curatorial staff in parks and centers. In 1983, the Associate Director, Cultural Resources, the Chief Curator, and key Service curators met to develop a curatorial strategy for managing the park museum collections from 1984 to 1990. Five goals were established.

1. Establish minimally adequate storage and preservation for all collections.
2. Establish accountability for museum property.
3. Strengthen curatorial expertise in the field.
4. Incorporate curatorial review in the planning process.
5. Improve collections management policy guidance to the field.

In developing this strategy, the National Park Service established a long-range program to guide the present and future direction of managing the museum collections in its custody for the public trust. In 1982, the National Catalog Steering Committee was established to advise the Curatorial Services Branch on cataloging issues. The revised NPS Museum Handbook, Part II, Museum Records was issued in 1984. It provided parks with streamlined procedures for accessioning and cataloging museum objects. In 1985, a Servicewide call was issued for every park unit to have an approved Scope of Collection Statement. As a result, by 1986 each park unit had an approved Scope of Collection Statement. The NPS Natural History Collections Committee, composed of natural science specialists and curators, was established in 1985 to advise the Chief Curator on policy issues and the planning, management and use of Service natural history collections.

In 1986, a survey conducted of park units indicated that there were over 25 million objects in the Service's museum collection. The number of objects in each discipline were estimated to be as follows:

Archeology -	17,352,000	(67.89%)
Ethnology -	28,000	(0.11%)
History -	1,632,000	(6.38%)
Archives -	6,301,000	(24.67%)
Biology -	231,000	(0.03%)
Paleontology -	8,000	(0.03%)
Geology -	9,000	(0.04%)

It was estimated that the Service had a cataloging backlog of over 22 million objects. As part of the survey, parks established target dates and cost estimates for cataloging the backlog of objects. During the same year, revised standards for storage, environmental control, security, and fire protection were issued in a revision of Special Directive 80-1, Guidance for Meeting NPS Preservation and Protection Standards for Museum Collections. Each park completed a self-assessment of its museum collection relative to these standards. The results of this assessment

indicated over 6,000 procedural and facility deficiencies in 294 park units. The regions established action plans, target completion dates, and estimated costs for correcting all the identified deficiencies.

The Curatorial Services Branch became a division in 1987. A request from Congress in the Fiscal Year 1987 Appropriations Act elevated the level of interest in NPS museums. The Act directed the Service to submit with its Fiscal Year 1988 budget request a plan for museum collection management in the National Park Service. The plan, submitted in March 1987, established needed funding levels to eliminate the cataloging backlog and to provide acceptable preservation and storage conditions by the year 2000. During this year, Servicewide procedures for using the NPS Clearinghouse were developed and issued to assist parks with disposing of excess and acquiring needed museum objects. A major accomplishment for the Servicewide curatorial program was achieved in 1987. The Automated National Catalog System (ANCS) Manual and program software was distributed to parks to accelerate accountability for museum collections.

C. NATIONAL PARK SERVICE MUSEUM COLLECTIONS

The National Park Service is one of the primary Federal agencies that preserves cultural and natural resources and is a major repository for cultural and natural history collections in the United States. NPS museum collections represent a multitude of disciplines and constitute a significant portion of the resources that the Service is charged to preserve and protect. Collections are directly related to park themes and resources. In some instances, the collection is the primary reason for establishing the park.

Both cultural and natural history collections preserve important aspects of this country's heritage. They make parks more understandable for visitors by providing something tangible to tie to the park story. They aid scholars who study the past and present, and offer insights into the future. They provide the framework that supports ideas, events, and features commemorated in National Park areas.

1. Cultural Collections

The diversity of Service sites is reflected in its cultural collections. These collections document human habitation, activity, invention and creativity from pre-historic times to the present. They include both artifacts and natural objects used in specific ways during human activities. They help us to learn about and understand earlier cultures, as well as our own and contemporary cultures. Park museum collections complement and substantiate other sources of knowledge about people, events and times that are commemorated in National Park Service sites. Sometimes objects are the most valuable sources available. Cultural collections encompass archeological, ethnographic and historical materials.

Archeological Collections

Archeological collections constitute approximately 70% of the Service's total museum collection. An archeological collection consists of two general categories of materials: the recovered objects (e.g., artifacts and environmental specimens), and the records that document the collection and the study of that collection (e.g., field and laboratory notes, photographs, maps, drawings, computer documents, reports and manuscripts). The records that document the collections are the keys to the collection's research potential. An archeological collection is only as good as the records that document it.

While archeological collections most frequently bring to mind prehistoric Native American artifacts, archeology uses a method of study that does not limit the discipline to a specific time period or ethnic identification. Archeology collections may represent any time in human history as long as the material was recovered by archeological methods.

Archeological methods employ well-planned procedures of collection and analysis that are formulated and designed to ensure thoroughness and regularity in data recovery. Their goal is to produce a systematic collection (e.g., a unified collection of related data and objects). The objects in these systematic collections have the critical quality of context that relates them to each other, the features of the site from which they are removed, and the people who made or used them. Objects obtained through archeological study of both historic and prehistoric sites are classified as archeological collections.

The process of an archeological investigation transfers objects from their original location in an archeological site to an arbitrary location in an archeological collection. Once the site is altered, the objects and the records that document the collection and the archeological investigation often are the sole resources that remain from the site. They must be preserved for future generations. The proper management of the collection in order to maintain its systematic integrity cannot be compromised.

The value of systematic archeological collections is the information that may be obtained through research. Because cultural resources are finite and most archeological procedures are destructive, the systematic collection often contains the only information of its kind available for understanding and interpreting the resource. Well-documented systematic collections may be used for new research instead of excavating additional sites, thus leaving other resources undisturbed. Using artifacts from systematic collections in exhibits is appropriate providing steps are taken to protect and preserve the systematic integrity of the artifact and to ensure that the exhibit environment does not affect its research value.

NPS archeological collections document a broad range of human activity. From Anasazi cliff dwellings (Mesa Verde National Park) and monumental architecture (Chaco Culture National Historic Park) to the 17th century glassworks of Jamestown (Colonial National Historical Park) and the 18th century public and domestic collections in Philadelphia (Independence National Historical Park) to the late 19th century camp life of the 10th U.S. Cavalry--one of two mounted Black units in the U.S. Army between 1868 and the mid-1990s (Chiricahua National Monument), these materials contribute significantly to the understanding of our own and earlier cultures.

The Service usually acquires an archeological collection within a park's boundaries as a result of a research project or as a result of a park management need. In the latter case, a site area may be studied and the objects and the data preserved to lessen the impact of an activity on the cultural resources or to protect the resources from a threat.

Ethnographic Collections

Ethnographic collections constitute only 0.1% of the total National Park Service museum collections. However, they are an important part of these holdings. Ethnographic collections are those obtained from members of contemporary cultures and, like archeological collections, consists of both objects and records that document their collection and study. While in theory ethnographic specimens may come from any contemporary population, virtually all National Park Service ethnographic collections are from Native American or Polynesian peoples who occupy, or occupied, the area of a park, or who have some other current or historical association with the park area. Ethnographic collections have a dual significance: they are significant to the culture of origin and serve as a vehicle through which others may learn about that culture.

Most ethnographic specimens in Park Service collections are the result of traditional manufacture. They range from simple utilitarian objects to religious items and works of art. Raw materials used in the production of ethnographic objects, such as pigments, fibers from cordage, cloth or basketry, and foodstuffs, are classified as ethnographic though they might otherwise qualify for inclusion in one of the natural history categories.

Ethnographic collections may be systematic collections documenting a discrete research project, such as a series of ceramic vessels in various stages of completion along with examples of the tools needed for accomplishing each step in the process of pottery-making. In such a case, any field notes, photographs or other records that are derived from the study should also be made a part of the collection in the same manner as with a systematic archeological collection. Sometimes a single collection assembled by an individual will be acquired and the collection will possess an integrity of its own that is worth preserving.

Many older ethnographic collections are the result of the collecting of curiosities for home decoration. As such, they often consist of items produced by native people for sale to outsiders and tell as much about the relationships between two cultures as they do about the cultures of origin.

NPS ethnographic collections range from materials gathered to document the heritage of a native people (Nez Perce National Historical Park) to baskets documenting the development and change in basketmaking techniques in California (Yosemite National Park) to items originally intended for commerce (Hubbell Trading Post National Historic Site) to pieces acquired as furnishings in historic structures (Grant-Kohrs Ranch National Historic Site). They provide valuable information about the life and traditions of a group of people.

Native peoples who have a personal or cultural affiliation with ethnographic collections, may want to be involved in the decisions regarding the care and use of these objects. It is the policy of the National Park Service to consult with appropriate groups and individuals in such decisions. As a matter of NPS policy, disinterred skeletal or mummified human remains are never displayed and sacred objects are displayed or used only after consultation with appropriate groups.

History Collections

History collections constitute about 31% of the Service's total museum collection and encompass the entire spectrum of materials made and used by cultures with a written tradition up to the present. The size and diversity of history collections vary substantially from park to park. These collections may document people and events or represent inventions and occupations; they often provide insight into peoples' lifestyles and sometimes into their deaths. Taken together these diverse assemblages provide an important component for fully understanding and appreciating our past.

Furnishings for historic structures, from the most elegant textile, painting or piece of furniture to the undecorated kitchen utensil, are found in vast numbers in NPS collections. Historic structures also provide architectural elements or fragments that form important reference collections. Military sites provide a full range of weapons, accoutrements and personal artifacts, all enabling us to better understand the events of the period. Industrial and technological collections document the activities of individuals as well as large enterprises. Personal artifacts owned by individuals commemorated at parks can be particularly special collections. Although fewer in number, fine arts collections are also part of NPS history collections.

Archival and manuscript collections constitute 79% of the history collections. Such collections include documents, manuscripts, and photographs, and are especially valuable history collections. Their site-specific relevance is important in the interpretation of individual NPS units, but their intellectual content often is also meaningful well beyond a park's boundaries.

The wealth of NPS history collections ranges from the inventions, products and archives of the life and work of Thomas Edison (Edison National Historic Site) to the library and personal possessions of literary figure Carl Sandburg (Carl Sandburg Home National Historic Site) to a significant architectural study collection (Independence National Historical Park) to the medals and sculptures created by artist Augustus Saint-Gaudens (Saint-Gaudens National Historic Site), to photographs of Carlton Watkins and George Fiske (Yosemite National Park), to Civil War military armaments and artifacts (Gettysburg National Military Park, Vicksburg National Military Park, and Shiloh National Military Park).

While the value of a Chippendale chair owned by George Washington is readily apparent, the value of a 1950's chair from an historic ranch house may not be. Yet both document the way of life of Americans, and both are part of the cultural heritage of the American people. Park historical collections often consist of everyday items from the past, and it must be realized that their significance is their ordinariness and how they illustrate the life of Americans. The value of historical collections rests with this illumination, and not necessarily with the fact that the objects were owned by an eminent figure.

The relationship between historical objects and their setting is crucial. At best, historical furnishings out of context tell us a little about life in a particular period, and at worst they can be misleading. Collections or individual objects that can be documented to a particular NPS site have the greatest level of relevance and significance.

Period items that are similar to those original to a site are also extremely significant. In instances where few or none of the original objects remain, or where adding original pieces to the NPS collection is impossible, contemporary historical objects fill an important role. NPS history collections may also contain reproductions purchased to fill specific gaps in the collection. They are also used when the original object is too fragile to be used for any purpose other than infrequent study. Both period representations and reproductions must be clearly identified as such, so as not to be mistaken for objects original to the site.

2. Natural History Collections

Natural history collections constitute approximately .9% of the total National Park Service museum collections. These collections are rapidly growing because of increased research activities in parks. Natural history collections serve a number of purposes, and are of value to both scientists and the general public. They are generated as a part of approved research projects conducted by Service employees and/or outside scientists. Natural history collections are important educational and interpretive tools within the parks. They can assist the park staff in learning more about the plants, animals, fossils, and geology of the area. Collections of specimens obtained within the park boundaries can be used for exhibits that help visitors understand the environment. Complete natural history collections, representative of the biotic and abiotic elements found within the park, can document distribution and composition of these park resources. Baseline species inventories can be used to monitor environmental changes, aiding scientists in preserving and protecting park resources for the future. Natural history collections also can act as a link to the scientific community; quality specimens found within a park can serve as voucher or representative specimens of the biotic and geologic community. Occasionally special collections are

made of particular species which have a direct relationship to the establishment or function of the park. Scientists wishing to do in-depth studies on these specimens can use these materials. Occasionally, the collections are more important because of the collector than because of the specimens themselves. Natural history collections encompass biological, geological, and paleontological materials.

Biological Collections

The establishment and maintenance of properly documented biological collections are important functions which support the management of parks. Biological collections help establish a resource baseline documenting the presence in the park of species or groups of species at a given time. These collections are useful to many people. Scientists use collections to determine if changes have occurred in the park's environment and if those changes are due to ecological processes or are the result of human influences. Historians, historical architects and historical landscape architects can use collections to restore a park's historic scene.

For example, osteological collections could help determine if gross nutritional changes have occurred in a species diet over time. Egg collections made before the development and use of organochlorine pesticides were used to help document the thinning of bird egg shells caused by the insecticide DDT. Scientists may also use park biological collections as part of taxonomic studies or other species-specific research. Herbaria establish a permanent base of information about indigenous and exotic plants that can assist historians, historical architects and historical landscape architects in restoring and maintaining historic scenes and landscapes. Interpreters may use biological collections in concert with geological and paleontological collections to increase their awareness, and therefore, park visitor awareness of the interactions of environmental forces and biota which helped shape the contemporary park landscapes. Resource managers may utilize information gained from biological collections to identify resource management needs as part of formulating Resources Management Plans.

Biological collections should include specimens from all key taxonomic groups found in the park such as mammals, birds, fish, reptiles, amphibians, vascular plants, lichens, fungi, insects, molluscs, and even algae and protozoa. Often overlooked for inclusion in biological collections is evidence of plant or animal presence, such as casts of tracks or tunnels, nests, seeds or pollen. Knowledge of the diversity of park biotas gained from such collections will help increase our understanding of the ongoing ecological processes that occur in and around the parks.

NPS biological collections document a number of the species that inhabit national park units. They include Liguus Tree Snails (Everglades National Park), a number of herbaria (Great Smoky

Mountains National Park), and voucher specimen collections (Yosemite National Park, Grand Canyon National Park, and Glacier National Park).

The methods of preserving biological collections for future purposes are diverse. For example, while most plant collections consist of dried specimens mounted on herbarium paper, other plant collections include specimens preserved in liquids, specimens mounted on microscope slides (algae or pollen), and seeds or other forms of germ plasm stored in cold temperature seed banks. Similarly, many of these preservation techniques also are applied to animal specimens, and in addition, some animal specimens are preserved by freeze drying or as taxidermic mounts.

Biological specimens must be collected and preserved in a systematic method, unless the specimen or specimens are of historic significance. Extensive and precise documentation of specimens must be maintained to ensure that information gleaned from specimens is available and useful. For this reason, copies of field records (e.g., field notebooks, photographs, negatives, drawings, maps, raw data sheets, instrument charts, remote sensing materials) should be maintained as integral parts of the collection.

Proper monitoring and maintenance of biological collections should be conducted to prevent specimens from being damaged by improper environment and by a variety of pests including insects, mammals, fungi or bacteria. Routine monitoring is necessary because it provides for the rapid detection of pests or the detection of the conditions that support pests. When control of pests is necessary, control measures should be carefully planned to avoid those methods that damage or alter preserved specimens or leave residues, all of which may render the specimens useless for future studies.

Geological Collections

Geological collections provide information on the physical evolution of the earth. Geological specimens illustrate the composition of the substrate upon which the area's principal resources are developed, and they document, at selected periods in time the processes that have brought the area to its present state.

A primarily geological, natural area will be represented by the principal rock types of its terrain, its surficial deposits, its structures, or deposits of special interest. An area noted for its biological resources is inextricably tied to its bedrock, regolith, or soil, and sometimes even slight compositional differences are reflected as variables in ecosystems. Historical sites are closely related to their geology. A carefully prepared and exhibited soil profile can demonstrate why a farm was successful or not successful. Battlefields show the importance of including geological knowledge in decision-making, as in selection of sites for breastworks and forti-fication. Representative samples of geological materials reveal the

unfolding history of changing climate, topography, volcanic activity, and human influences, many of which determine the characteristics of an area today or suggest how it will be in the future.

Specimens must be documented to describe their context as completely as possible. In addition to the exact location on a map, the location within associated geological deposits is required (e.g., "basal conglomerate at the top of the Chugwater formation", or "ash layer at depth of 35 cm in core R-5"). This information is contained in the field notes and records made when the specimens were collected. Often a reference to a research report, field notes, map, or other document is required, and copies should be a part of the collection. Certain specimens must be marked directly to indicate which side is up and which direction is north. Excellent documentation and preservation of specimens ensures their availability for a variety of sometimes unanticipated future uses. For example, properly preserved soil samples predating a pesticide spraying program may help to document the extent of change in the soil since that time.

Certain voucher samples are ideal for frequent study. A representative collection of rock or mineral specimens exhibiting the broad range of characteristics of a geologic process (e.g., a volcanic flow unit) may be studied by researchers in the museum, therefore, reducing the need for field work and new collecting permits. This can be an important resource protection strategy for areas with fragile or limited resources, and many geologists are willing to collaborate with park curatorial staff in establishing such collections. Geological resources affect nearly every park. Areas of special interests to geologists include Grand Canyon National Park, Yellowstone National Park, Zion National Park, Death Valley National Monument, and Hawaii Volcano National Park.

A rock specimen contains considerable information when it is properly documented and preserved in a museum collection. Its mineral composition, structure, and texture tell us about the origin of the unit from which it came (e.g., a granitic pluton). Its surface may contain the imprints of the physical processes involved in its most recent history (e.g., glacial striations). Its chemical alteration may record the weathering process through breakdown of feldspars and oxidation and hydration of other minerals. Finally, it retains subtle evidence of such things as: the direction and strength of the earth's magnetic field when it formed; its age; the depth of burial when it cooled; the length of time expired since it was exposed by erosion; the energy of the glacial or fluvial environment that shaped and scarred its surface; and the chemical composition of the air and water in contact with it during weathering.

Paleontological Collections

Paleontological collections or fossils, constitute our only record of 3.5 billion years of life on earth. They range in size from microscopic pollen and spores studied with scanning electron

microscopes to dinosaurs 100 feet in length. Fossils often consist of hard parts (e.g., bone or some type of external skeleton). Fossils may also consist of impressions of soft bodied organisms (e.g., leeches) or may contain preserved cellular tissue (e.g., muscle, skin). Fossils constitute direct evidence of the history of life on our planet and provide critical data for diverse studies.

Fossils are divided into the main categories of body fossils and trace fossils. Body fossils are the result of mineral replacement of soft or hard tissues (such as bone), while trace fossils are the result of organismal activities (tracks, trails, coprolites). Both types of fossils provide the only data for a wide range of studies on past life in fields such as phylogenetics, morphology, paleohistology, depositional environments, migration, competition, extinction, evolutionary rates, speciation patterns, paleoclimatology, and paleoecology. Fossils also provide important data on the origin and evolution of modern biota.

The rich record of past life preserved on NPS lands ranges from 1-billion-year-old algae (Glacier National Park) to 140-million-year-old dinosaurs (Dinosaur National Monument) to 35-million-year-old beetles, butterflies and leaves (Florissant Fossil Beds National Monument) to fossil mammals only a few thousand years old (Channel Islands National Park). Many of these deposits have long been recognized by paleontologists worldwide as superlative examples of particular episodes in the history of life. As such, they constitute scientific resources of national and international significance.

Collections of fossils are generated for several reasons. Fossils are very vulnerable to weathering and erosion. Once exposed, a specimen could be washed away and destroyed by a single rain-storm. Clearly it is not possible to adequately manage and protect fossils in the field. Once exposed, they must be collected and placed in a museum collection to be preserved. Fossils may also be added to collections as baseline data on the past distribution of park resources. Such information is critical so that management actions will not adversely affect these collection sites. Fossils may also come into collections through building and road construction, trail construction, or any other park activity where excavations occur.

Although staff and vistors may bring isolated finds of fossils into the museum, such collections should be discouraged as the locality data supplied is often inadequate for scientific purposes. Factors used by paleontologists to evaluate the quality and scientific value of fossils include completeness of the specimen, its size, and its geographical distribution.

D. INTRODUCTION TO NPS MUSEUM COLLECTIONS MANAGEMENT

A museum object is a "material thing possessing functional, aesthetic, cultural, symbolic, and/or scientific value. An object is usually movable by nature or design, such as a coin, a gun, a ceramic pot, a chair, a canoe, or an automobile. Museum objects include prehistoric and historic objects, artifacts, works of art, archival materials, and natural history specimens that are part of a museum collection. Elements, fragments, and components of structures may be designated museum objects if they are no longer part of the original structure. Large or immovable properties, such as monumental statuary, trains, nautical vessels, cairns, and rock paintings, are considered to be either structures or features of sites."[1]

Museum collections management is a process not a product. It is a systematic approach to the proper preservation and the wise use of museum objects. It includes any activity associated with the acquisition, accountability, documentation, conservation, protection, disposition, and use of museum objects. It involves assessing and planning for the short-term and long-term needs of a collection as well as carrying out the day-to-day activities of caring for objects on exhibit and in storage. The goal of collections management is to make museum collections available to the user for exhibit and study while preserving them for future generations.

1. Mandate for NPS Museum Collections

   The five laws that provide the basic legal mandate for the National Park Service to undertake collection management are listed below. Refer to Appendix A for pertinent excerpts from each law.

   Act for the Preservation of American Antiquities, June 8, 1906 (16 USC 431-433)

   Organic Act of 1916 (16 USC 1 et seq.)

   Historic Sites Act of 1935 (16 USC 461-467)

   Museum Properties Management Act of 1955 (16 USC, Sect. 18 [f])

   Archaeological Resources Protection Act of 1979 (16 USC 470aa-mm)

A list and description of other laws, regulations, conventions and special directives that are pertinent to museum collections, and the NPS Management Policies (Dec. 88) that give specific requirements for the acquisition and preservation of museum objects are included in Appendix A. In addition, refer to Appendix A for the NPS standards for managing museum objects.

2. Responsibility for Collections Management

   Every National Park unit with a museum collection, regardless of size and scope, is part of the broader NPS museum system. The

responsibility for managing the National Park Service museum collections is shared by three administrative levels: Washington Headquarters, Regional Offices, and Parks. Museum support services are also provided by the Harpers Ferry Center and the Denver Service Center.

a. Washington Office (WASO)

Under the office of the Associate Director, Cultural Resources, the Curatorial Services Division is responsible for developing Servicewide policies and procedures for the acquisition, accountability, documentation, conservation, storage, security, and disposition of NPS museum collections and for their use and interpretation. The Curatorial Services Division is responsible for maintaining: the NPS National Catalog of Museum Objects; operating the NPS Clearinghouse to assist parks in acquiring and disposing of objects according to the approved Scope of Collection Statement for the park; Servicewide curatorial training; providing collections management planning assistance to parks; publishing Conserve O Grams; developing technical information relating to collections conservation and care; and maintaining a centralized museum supply and equipment program.

b. Regional Offices

In each regional office, the Regional Curator is responsible for providing support and management oversight to assist parks in implementing the policies and procedures for managing museum collections. The Regional Curator works with the Curatorial Services Division in developing, reviewing, and implementing Servicewide curatorial policies and procedures; assists in the planning, programming, and budgeting for collections management; facilitates curatorial training and technical assistance; and coordinates with other NPS and non-NPS discipline specialists (e.g., conservators, historians, archeologists, historical architects, historical landscape architects, interpreters, safety engineers, and law enforcement coordinators) on curatorial matters. At the regional level, archeological and conservation centers provide collections management support and services to parks. Some of these centers provide a centralized repository for storing and curating park collections. Some centers, such as the Western Archeological and Conservation Center, serve several regions.

c. Parks and Centers

The responsibility for day-to-day management of museum collections is at the park or center level. The Park Superintendent or Center Manager has the ultimate responsibility for the accountability, preservation, protection and use of the unit's museum collections. The Park Superintendent recommends or approves all planning documents that are related to the proper management of the museum

collections. The day-to-day care for a park's collection is delegated by the Superintendent to park staff. Park curatorial staff also undertake the responsibility of researching and interpreting the collection. In some parks, this responsibility is carried out by museum curators, specialists, technicians, and aids. In most parks, curatorial responsibility is carried out by rangers, interpreters, and resource management specialists as a collateral duty.

d. Harpers Ferry Center (HFC)

The Harpers Ferry Center's primary museum function is to plan, design, produce, and rehabilitate museum exhibits and historic furnished areas. The Division of Exhibit Planning and Design prepares exhibit plans and designs, either in-house or on contract. The Division of Museum Production prepares contract specifications and supervises production and installation of museum exhibits. The Division of Historic Furnishings prepares historic furnishing reports, produces exhibits of historic furnishings, and helps parks plan and operate furnished historic structure museums. The Division of Conservation performs conservation treatment on museum objects, prepares collection condition surveys, recommends environmental needs in exhibit case design, and helps train staff in preventive conservation of objects on exhibit and in storage.

The Branch of Library, Archival Services, and Graphics Research helps parks manage library collections. It is the repository for the National Park Service History collection of documents, uniforms, photographs, and memorabilia. The Branch maintains an extensive collection of park photographs.

e. Denver Service Center (DSC)

The Denver Service Center coordinates the major planning, design, and construction program of the Service. Planning documents (e.g., General Management Plan, Development Concept Plan) that may include museum program elements are prepared by center teams. The construction or rehabilitation of facilities, including historic structures that may house museum objects, may be coordinated by the Center's staff.

E. PLANNING FOR PARK MUSEUM COLLECTIONS

The Service requires that a series of planning documents be written and reviewed during the development and operation of each park. To establish museum collections management and interpretation as legitimate park functions, they must be integrated within the overall planning process that encompasses all park resources. When collections management requirements are integrated into a park's planning process, and park management is effective in implementing the approved plans, the park's museum collection will be assured of proper documentation, preservation, and interpretation. NPS-28, Cultural Resources Management Guideline, Managers' Guide, Chapter 2 provides detailed information on the NPS planning process as it relates to cultural resources. Planning is the first step in programming to fund museum collections management projects. Refer to Chapter 12 for guidance on programming and funding for museum collections management.

1. General Park Planning Documents[2]

There are seven primary types of documents that play a critical role in the establishment and development of a park and pertain to the development of museum collections. These documents proceed from the general to the specific and establish a frame of reference for decision making based on law, policy, objectives and resource characteristics.

- **Preauthorization and Authorization**

  Before an area is added to the National Park System, studies are conducted to assess the significance of resources, their current use and protection and to identify any conditions and constraints that should be considered if the area is to be brought into the system. Objects, if present, should be part of this evaluation.

  The purpose of a National Park Service area is usually defined in the legislation, presidential proclamation, or executive order establishing the area. In rare cases, the preservation of objects is a part of a park's legislative mandate (e.g., Edison National Historic Site, Frederick Law Olmsted National Historic Site, San Francisco Maritime National Historical Park, and Carl Sandburg Home National Historic Site). When legislation for a park does not specifically mention objects, the determination of whether a park will establish and maintain object collections is made in subsequent planning documents.

- **Statement for Management (SFM)**

  The first document in the planning cycle is the Statement for Management. It is a brief document providing an overview of the purpose, resources, major issues, and management objectives of the park. It also includes a listing of the National Park Service themes that are represented within the unit.

In this document, the purpose and objectives of the museum collections, if any, are broadly stated and the contents of the collections are analyzed for significance. Highly significant objects or specimens are noted. Particular issues and deficiencies, such as uncataloged objects, lack of adequate storage and fire protection, and lack of preservation maintenance procedures for objects are listed. The need for, or status of, planning and inventory documents pertaining to collections is also described.

The SFM is prepared by park staff and updated every two years. Based on an approved SFM, park management can undertake emergency stabilization actions to preserve park resources. Major actions, however, cannot be initiated until the park has an approved General Management Plan.

- **Outline of Planning Requirements (OPR)**

The Outline of Planning Requirements is a regularly updated document that lists in priority order, the plans and projects identified in the Statement for Management. This list guarantees that projects will be accomplished in a logical sequence, according to the greatest need. The OPR is compiled from programming documents that have been submitted to describe projects and request funding.

The needs of the collections must be fully described in the OPR, as well as the effects on the resource, if those needs are not met. Also noted are policy requirements and legislative mandates pertaining to the management of the collections. The OPR is a critical step toward the preservation and management of museum collections. To receive adequate recognition by management, museum collection needs must be clearly stated, their urgency must be accurately assessed, and the need for the project to meet legislative mandates or National Park Service policies, guidelines, and directives must be demonstrated. Care must be taken that requests are listed in a logical sequence with prerequisite tasks receiving higher priority.

For a newly created park, a collections need that might be identified through the OPR is writing a Scope of Collection Statement to identify types of objects appropriate for park collections. Other needs that might be identified in the OPR include a Collection Management Plan, a Collection Condition Survey, and a Historic Furnishings Report.

- **General Management Plan (GMP)**

Every unit of the National Park System is required by law to have a General Management Plan. This plan provides long-range strategies for addressing issues and achieving management objectives over a five to ten-year period. The plan covers two types of strategies,

those to preserve and manage the parks's resources, and those to provide for interpretation and visitor use. Museum collections are affected by both objectives.

This document should identify long-term collection management needs. If there is an extensive backlog of uncataloged collections, the need to bring catalog records up-to-date and gain accountability for the objects should be identified. If the collections have inadequate storage conditions, the GMP may call for the writing of a Collections Storage Plan and for constructing and equipping a new storage facility.

A project that provides for interpretation and visitor use might be a park manager's desire to furnish and interpret an historic structure. The plan may identify the need for an Historic Furnishings Report.

- **Development Concept Plan (DCP)**

The Development Concept Plan expands on decisions made in the General Mangement Plan relative to a particular area or unit of a park. It is a detailed plan for that unit, specifying the size and location of new facilities and relating them to exiting facilities. If objects are to be collected, stored or interpreted in the developed area, the necessary actions need to be identified. Careful consideration needs to be given to any proposed historic structure treatment or archeological project to determine if these activities will result in the collection of objects that will need to be documented and preserved.

- **Resources Management Plan (RMP)**

As a matter of policy, all parks are to have Resources Management Plans that identify and rank, according to priority, importance and urgency, natural and cultural resource management problems, and that propose a schedule for taking action to resolve them. In many cases, problems identified in the previous plans will be restated and further developed in the RMP, depending on the significance of the resource and the urgency of the problem.

The plans are updated annually and are dynamic documents. The plan assesses the extent to which the park has met Servicewide requirements for resource inventory, evaluation and documentation, and serves as the primary means of identifying needed plans, studies, and preservation treatment.

The RMP should briefly summarize the content and size of the museum collection, and describe the status of object cataloging and of storage and exhibit space conditions. Parks with collections that are uncataloged, stored in conditions detrimental to their preservation, or subjected to unnecessary security or fire risks,

must identify these and other urgent problems in the Resources Management Plan. Collections-related actions that might be identified through the RMP include, but are not limited to:

- Write a Collection Management Plan that will identify collection management deficiencies and recommend specific corrective actions.

- Accession and catalog the backlog of uncataloged objects; send records to the National Park Service National Catalog of Museum Objects.

- Reorganize the storage area and purchase new storage equipment to provide adequate preservation and security for the collections.

- Conduct a Collection Condition Survey to determine the condition and stability of objects in the collection and identify specific objects needing conservation treatment.

- **Interpretive Prospectus (IP)**

The Interpretive Prospectus evolves from the General Management Plan. The General Management Plan identifies the broad scope of the interpretation program and the IP describes how it will be accomplished. It defines personal and non-personal services (e.g., media, facilities) that will be used, establishes production priorities, and provides cost estimates for implementation. It leads to the development of a Statement for Interpretation, a document that is updated annually and provides background data on interpretive themes and visitor use. The Statement for Interpretation includes an interpretive operations plan, which incorporates, as appropriate, use of museum objects in the interpretive program. The IP may also call for an Exhibit Plan or an Historic Furnishings Report.

2. Planning and Documentation Specific to Museum Collections

The six planning documents and one inventory described below are the essence of collections management and collections-oriented interpretive planning in the National Park Service. They are used in concert with the overall planning documents for a park to provide coordinated collections management and interpretation. The preparation of each of these documents is programmed into the park planning process through the general planning documents noted previously.

- **Scope of Collection Statement (SOCS)**

The Scope of Collection Statement, required by policy, defines and limits the museum collections of each park. Refer to Chapter 2 of this handbook for guidance on writing a Scope of Collection Statement.

- **Collection Management Plan (CMP)**

  The Collection Management Plan is a tool that is designed to assist each park in improving its museum collection management program. Refer to Chapter 3 of this handbook for guidance on this document.

- **Collection Condition Survey (CCS)**

  The Collection Condition Survey is a detailed survey of all or part of a park's collection, intended to evaluate the condition of each object and to establish priorities for conservation treatment. Refer to Chapter 3 of this handbook for guidance on this document.

- **Collection Storage Plan (CSP)**

  The Collection Storage Plan focuses on solving a park's museum storage problems. A storage plan often is included in a Collection Management Plan. It also may be prepared as a stand-alone document, especially to solve urgent collection storage problems before a Collection Management Plan is prepared, or to facilitate design of a new collection storage facility. It is often needed in association with a Development Concept Plan. Refer to Chapter 7 of this handbook for guidance on writing this plan.

- **Historic Furnishings Report (HFR)**

  The Historic Furnishings Report provides a history of a structure's use and interior appearance and, if appropriate, a plan for recreating the historic interior. The HFR contains administrative and historical data sections and, where appropriate, a furnishings plan. The administrative section identifies the location and proposed use of the structure, and includes data on administrative history. The historical data section includes documentary evidence of the historical use and occupancy of a structure and of its contents. If the structure is to be furnished, a furnishings plan section addresses interpretive objectives, operating plans, including recommendations for staffing and visitor circulation, and detailed plans for furnishing. Guidelines for furnishings installation and maintenance are prepared in conjunction with the furnishings plan.

- **Exhibit Plan and Design (EPD)**

  The Exhibit Plan and Design evolves from the Interpretive Prospectus and provides the label copy, list of objects to be exhibited and detailed design and construction plans for an exhibit. It must take into consideration the preservation and security needs of objects placed on exhibit. This plan and design includes specifications for environmental needs (e.g., relative humidity, temperature, light, dust), security, and access to exhibit cases.

- **National Catalog of Museum Objects (NC)**

  The National Catalog of Museum Objects is an inventory of all museum objects and specimens in the National Park System. Standardized museum catalog records are completed and filed in the parks, with one copy being sent to a centralized file. The catalog record contains property management as well as documentary data for museum objects. Refer to NPS Museum Handbook, Part II, Museum Records, and the Automated National Catalog System (ANCS) User Manual for guidance on cataloging museum objects.

  If objects are considered in a park's general planning documents and the collections-specific documents and inventories are completed as needed, then management decisions will give due consideration to collections and their role in the park. Many of these plans generate specific programming documents that detail actions to be taken to correct deficiencies or carry out the proposals recommended in the plans. These plans are not static. They are part of a dynamic system and constantly undergo alteration to meet the changing conditions of the resources, needs of the visitors, or other factors.

F. PROFESSIONAL CONSIDERATIONS

Fundamental to any museum is its collection of objects and specimens. Museums share common responsibilities to collections: collecting, preserving, researching, and exhibiting objects. The museum profession has established and implemented recognized standards and practices for properly carrying out these responsibilities.

The essence of a profession is its common goals and objectives. The museum profession recognizes the following characteristics that are common to other professions: possesses a body of literature; develops criteria and methods for evaluating how well it meets its standards and practices (accreditation); provides education and training to prepare individuals to carry out their work; and adopts a code of ethics. Park museums are linked to other museums by these shared goals and objectives.

1. Body of Literature

There is a wide variety of general and technical literature available to park museum staff on museums and collections management. The NPS Museum Handbook is the principle Service publication on museum collections management. It provides specific guidance on the documentation, preservation, and use of Service collections. The bibliography sections of each part of the handbook provide a basic list of books and articles on topics relating to museum collections management. NPS Conserve O Grams are brief, technical leaflets distributed periodically to provide park curatorial staff with up-to-date, detailed instruction on museum collection preservation and on curatorial health and safety issues.

2. Standards

The NPS Operations Evaluation Process provides criteria for internal evaluation of the curatorial program in a park against Servicewide standards. A Collection Management Plan prepared for a park is another way to evaluate how a park manages its museum collections. National Park Service units are encouraged to seek accreditation by the American Association of Museums (AAM). This process evaluates the park museum programs against national standards established by the AAM. Refer to Appendix B for the procedures for applying for accreditation by the AAM.

3. Education and Training

In-Service curatorial training opportunities include the Curatorial Methods Course, the Critical Issues: Workshop in Curatorial Management, and regional workshops. Many universities and colleges offer museum studies programs. Sessions on a wide variety of museum topics are presented at annual and regional meetings of the American Association of Museums and the annual meeting of the American Association for State and Local History. Technical workshops are provided by the Smithsonian Institution as well as several other regional and state museums and organizations. Contact the Regional

Curator for information about education and training opportunities in museum collection management. Appendix C provides a description of the organizations and societies that provide leadership and technical and funding assistance.

4. Code of Ethics

a. Standards of Conduct for NPS Employees

Preservation of the public trust is the guiding principle behind the laws, regulations, policies, and guidelines affecting employees of the National Park Service. The Department of the Interior Employee Responsibilities and conduct are contained in 43 CFR 20.735-17(h). Detailed discussion and regulatory citations can be found in NPS-28, Cultural Resources Management Guideline, Technical Supplement. Employees must demonstrate an awareness of the public trust involved in stewardship of museum property, the nation's heritage.

When an employee acts in a way that appears to use public property or public position for private gain, or when an employee shows disregard for the public trust, those actions reflect on the agency and all of its other employees.

b. Standards of Conduct for Curatorial Staff

"Curatorial staff" is used in this section to include all NPS employees who act on, have access to, or are accountable for museum property in the care of the National Park Service. Staff clearly included in this category are superintendents (accountable for all park museum property), object conservators, museum curators, museum technicians, museum aids, housekeepers, interpreters, park rangers and cultural or natural resource specialists. If these employees have regular access to an NPS collection, their actions should be guided by the following standards.

The NPS standards for managing museum objects (outlined in NPS-28, A Manager's Guide) includes the following statement: "Curators and others with collections management responsibilities, in addition to the standards of conduct that govern their activities as employees of the Department of the Interior, are expected to adhere to the Code of Ethics for Curators, as formulated by the Curators Committee of the American Association of Museums." Appendix D contains a reprint of the AAM Code of Ethics for Curators. Some of the ethical considerations for NPS curatorial staff are as follows:

1) Buying and Selling of Antiquities or Natural History Specimens

Antiquities, fossils, and other natural history specimens are three-dimensional objects that await interpretation by people

interested in the information they may provide. Some of these objects, collected or still in their original context, have been kept in public ownership for the benefit of all. **Employee trafficking in objects and specimens originating on public lands is illegal.**

2) <u>Personal Collecting</u>

Personal collecting in fields closely related to the resources of an employee's park is sensitive, and requires great care to avoid real or apparent conflict of interest. Possible pitfalls are accusations of theft if an object is missing from the park collection, of competing with the park if an object is purchased that fits the park's Scope of Collection Statement, or of graft if the employee does personal business with a dealer who also sells objects to parks.

Employees should refrain from collecting in areas related to their employment. If such a collection is maintained, employees should follow the guidance in the AAM Code of Ethics for Curators. Employees should provide the Superintendent or Site Manager with an up-to-date inventory of the collection, keep the private collection separated physically from the park collection, never acquire anything that has formerly been in a park collection, and assure that the park has first option to buy any objects within the park's Scope of Collection Statement that the collector plans to buy or to sell. The same restrictions should hold true for the employee's friends and relatives, who might be willing to act on the employee's behalf.

A special caution is necessary for collectors of natural history specimens. Parks often are prime ecosystems for the collection of rare species. All personal collecting by employees must be off-duty and outside the park. Any collecting within the park, by employees or by others, is subject to <u>36 CFR 2.5</u>, and collected specimens intended to be retained permanently must be accessioned into the park's museum collection.

3) <u>Appraisals</u>

Appraising is an area that is subject to conflict of interest. Park staff may assist a visitor with the identification of an object. However, the identification must avoid making any judgement relevant to monetary value. Park staff must be particularly sensitive to the difference between identification and appraising.

National Park Service employees are prohibited from assigning values to non-NPS owned objects. The curator can assist a visitor by showing reference sources on the particular type of unidentified object, by providing names of a few appraisers,

and by referring to the Internal Revenue Service donation regulations, if appropriate to the situation. **The curator must not appraise the object.** If a person decides to donate an object to the park, it is the donor's responsibility to obtain an appraisal that meets Internal Revenue Service tax deduction requirements.

If asked for assistance, parks must also be cautious not to favor particular appraisers for Park Service contracts or for public referrals. Base the selection of an appraiser on qualifications and not on considerations which might be construed as showing partiality. When making public referrals, suggest several sources rather than one. Also ensure that any appraiser selected has no personal or business interest in the objects involved.

4) Use of Collections

Personal use of objects from the park collection by employees or their friends or by other private individuals is strictly prohibited.

Collections are meant to be used as reference or exhibit material. This use must be consistent with the public trust responsibility that curators and other collection workers bear. **Employees must ensure that the use neither harms nor deteriorates the objects, nor that it reflects negatively on either the National Park Service or the employee.**

Interpretive uses need to be reviewed carefully to ensure that the use will not be harmful to the object(s). While exhibit use may endanger an object, use of museum objects in living history demonstrations is generally inappropriate. Any consumptive interpretive use of original museum objects must be approved by the Regional Director as required by NPS-6, Interpretation and Visitor Services Guideline.

Human remains and sacred objects pose special responsibilities. They may have strong emotional and spiritual values for the family, culture, or religious group to which they pertain. A good principle to follow in these instances is to treat the remains and associated funerary objects in a manner appropriate to the group's cultural practices. Park staff should consult with relatives, or members of the relevant cultural group, in order to obtain their views of appropriate treatment of the remains and associated funerary objects. Refer to the NPS Management Policies (Dec 88). Excerpts of policies relevant to Native American concerns are included in Appendix A, Section B.

5) Field Studies

For studies proposed to take place within park boundaries, approval and oversight should be guided by the concept that the

natural and cultural resources of a park are assets for which park staffs are held accountable by the American people. **All collections resulting from field studies conducted within a park's boundaries remain the property of the government.** Any loss or diminution of a park's resources must be offset by worthwhile justifications and by strong documentation of the action and preservation of the evidence.

Researchers, then, must show the public benefit that may result from their studies of park resources. They must be able to show that they are qualified to conduct the research, backed by a responsible institution, able to provide for the expeditious publication of the results, and capable of preserving the objects and associated field records in perpetuity at the park or at a repository.

For ethnographic and historical studies, and others that may include research outside the park, the same responsibilities exist, plus the extra concern for the park's relationships with its neighbors. The personal privacy of informants must be respected, along with the property rights of landowners on whose property part of the research may be conducted.

6) Outside Professional Activities

NPS curatorial staff often have the opportunity to pursue professional activities and interests outside their job responsibilities. Such activities may be paid or volunteered and may be in the same community or some distance from the park. Whatever the circumstances, the staff member must realize that his or her actions, even in an unofficial capacity, reflect on the Service. **Therefore it is of primary importance that there be no conflict or apparent conflict of interest between these outside activities and the individual's job responsibilities.**

Any outside activities must be cleared with the employee's supervisor and the appropriate ethics counselor before they are begun. Outside activities that offer even the slightest possibility for an apparent conflict of interest require extreme scrutiny. Departmental regulations relating to outside work and interests are contained in 43 CFR 20.735-23. **Dealing is specifically not approved in the AAM Code of Ethics for Curators.**

It is important to recognize the benefits that appropriate outside activites can bring the park and the Service: an individual whose knowledge and expertise are recognized beyond the National Park Service can improve the public's understanding of the NPS mission and open channels of communication and cooperation that might otherwise remain closed. As long as the activities do not affect an employee's job performance, operating a private consulting or research

service, teaching, participating as an AAM Museum Assessment Program Consultant or accreditation team member, or serving a local or regional museum association can be very beneficial. 43 CFR 20.735-10 states than an employee shall not teach, lecture, or write using information obtained because of his or her Government employment, except when that information has been or on request will be made available to the general public.

Keep in mind that employees are prohibited from using their official titles in conducting private business or participation in private or public group activities. Use is strictly limited to those occasions and circumstances where representation is official (43 CFR 20.735-17 [0]).

If staff have any questions regarding the applicability of the regulations, or need advice concerning a specific situation, consult the supervisor and the Assistant Ethics Counselor (Regional or Center Personnel Officer). Washington Office employees should contact the Deputy Ethics Counselor (the Chief Personnel Officer).

G. SELECTED BIBLIOGRAPHY

1. Purpose of National Park Service Museums

Alexander, Edward P.
1979 Museums in Motion, An Introduction to the History and Functions of Museums. Nashville, Tennessee: American Association for State and Local History.

Alexander, Edward P.
1983 Museum Masters - Their Museums and Their Influences. Nashville, Tennessee: American Association for State and Local History.

Burcaw, G. Ellis
1975 Introduction to Museum Work. Nashville, Tennessee: American Association for State and Local History.

Lewis, Ralph H.
1976 Manual for Museums, Introduction, pp. 2-3. Washington, D.C.: U.S. Government Printing Office.

Noble, Joseph Veach
1970 "Museum Manifesto," Museum News, 48:8:16-20. Washington, D.C.: American Association of Museums.

2. History of National Park Service Museums

Burns, Ned J.
1941 Field Manual for Museums, Chapter 1. Washington, D.C.: U.S. Government Printing Office.

Lewis, Ralph H.
1982 "Retracing Curatorial Developments in the National Park Service," Cultural Resources Management Bulletin, 5:4:1,6-7. Washington, D.C.: National Park Service.

Lewis, Ralph H.
1987 "Museum Collections Conservation: An NPS History." Cultural Resources Management Bulletin, 10:2:3,12-14. Washington, D.C.: National Park Service.

3. Scope of the National Park Service Collections

Archeology

Bower, John
1986 In Search of the Past, An Introduction to Archeology. New York: Universe Books.

Deetz, James
1967 Invitation to Archeology. Garden City, New York: Natural History Press.

Fagan, Brian M.
1981 In the Beginning: An Introduction to Archeology (4th edition) New York: Little Brown and Company

Heizer, Robert F.
1959 The Archeologist at Work: A Sourcebook in Archeological Method and Interpretation. New York: Harpers and Brothers.

Noel Hume, Ivor
1969 Historical Archeology. New York: Seminar Press.

Quimby, I.M.G. (Editor)
1978 Material Culture and the Study of American Life. New York: Norton.

Thompson, John M. A. (Editor)
1984 Manual of Curatorship - A Guide to Museum Practice, Chapter 21. London/Boston: Butterworths.

Ethnography

Barrett, Richard
1984 Culture and Conduct. Belmont, CA: Wadsworth Publishers.

Brugge, David M.
1987 "Cultural Use and Meaning of Artifacts." Washington, D.C.: National Park Service, Cultural Resources Management Bulletin, Volume 10, Number 1.

Frisbie, Charlotte J.
1982 "Talking About and Classifying Navajo Jish or Medicine Bundles." page 98-109. in Navajo Religion and Culture: Selected Views, Papers in honor of Leland C. Wyman. David M. Brugge and Charlotte J. Frisbie editors. Santa Fe: Museum of New Mexico.

________________.
1987 Navajo Medicine Bundles or Jish. Albuquerque: University of New Mexico Press.

Murphy, Robert
1979 Overture to Social Anthropology. Englewood Cliffs, NJ: Prentice Hall.

Parks, Michael Allen
1986 Anthropology: An Introduction. New York: Harper and Row.

History

Bullock, Orin M., Jr.
1983 The Restoration Manual. New York: Van Nos Reinhold.

Blumenson, John J. G.
1985 Identifying American Architecture. Nashville, Tennessee: American Association for State and Local History

Daniels, Mayjene and Walch, Timothy, editors.
1984 A Modern Archives Reader: Basic Readings on Archival Theory and Practice. Washington: The National Archives Trust Fund Board.

Hosmer, Charles B., Jr.
1981 Preservation Comes of Age. Charlottesville, Virginia: University Press of Virginia.

Hume, Ivor Noel.
1970 Artifacts of Colonial America. New York: Alfred A. Knopf.

Milley, John C., editor
1980 Treasures of Independence: Independence National Historical Park and Its Collections. New York: Mayflower Books, A Main Street Press Book.

Pederson, Ann E., editor.
1987 Keeping Archives. Sydney: Australian Society of Archivists, Inc.

Peterson, Harold L.
1970 American Interiors: From Colonial Times to the Late Victorian. New York: Charles Scribners' Sons.

Schlereth, Thomas J.
1980 Artifacts and the American Past. Nashville: AASLH.

Seale, William.
1981 The Tasteful Interlude: American Interiors Through the Camera's Eye, 1860-1917. Nashville: AASLH.

Society of American Archivists.
1977-1982 Basic Manuals, Series I and II. Chicago: Society of American Archivists.

Todd, Frederick P.
1980 American Military Equipage. Providence, RI: Company of Military Historians. 1974; rpt. New York: Charles Scribners' Sons.

Biology

Banks, R. C. (Compiled and Annotated)
1979 Museum Studies and Wildlife Management. Washington, D.C.: Smithsonian Institution Press.

Lee, Weton L., Bell, Bruce M., Sutton, John F.
1982 Guidelines for Acquisition and Management of Biological Specimens. Lawrence, Kansas: Association of Systematics Collections.

Kim, K. C. and Dingley, M.
1986 Foundations for a Biological Survey. Kansas: Association of Systematic Collections.

Miller, E. H. (Editor)
1985 Museum Collections: Their Roles and Future in Biological Research, British Columbia Provincial Museum No. 25, Occasional Papers series. British Columbia, Canada: British Columbia Provincial Museum.

Geology

Brunton, C. H. C., Besterman, T. P., and Cooper, J. A.
1985 Guidelines for the Curation of Geological Materials (Geological Society Miscellaneous Paper No. 17). London: Geological Society, Geological Curators Group.

Thompson, John M. A. (Editor)
1984 Manual of Curatorship - A Guide to Museum Practice, Chapter 20. London/Boston: Butterworths.

Paleontology

Ager, Derrek V.
1963 Principles of Paleontology. New York: McGraw Hill Company.

Andrews, Henry N.
1961 Studies in Paleobotany. New York: John Wiley and Sons.

Carroll, Robert L.
1987 Vertebrate Paleontology and Evolution. New York: W. H. Freeman and Company.

Colbert, Edwin H.
1980 Evolution of the Vertebrates. New York: John Wiley and Sons.

Moore, Raymond C., et. al.
1952 Invertebrate Fossils. New York: McGraw Hill.

Moore, Raymond C., editor
1953 Treatise on Invertebrate Paleontology, Volumes 1-20. Boulder, CO: Geological Society of America.

Stewart, Wilson N.
1983 Paleobotany and Evolution of Plants. New York: Cambridge University Press.

4. Museum Collections Management

de Torres, Amparo R. (Editor)
1990 Collections Care: A Selected Bibliography. Washington, D.C.: National Institute for the Conservation of Cultural Property.

Guthe, Carl E.
1964 The Management of Small History Museums (Second Edition). Nashville, Tennessee: American Association for State and Local History.

Malaro, Marie C.
1985 A Legal Primer on Managing Museum Collections. Washington, DC: Smithsonian Institution Press.

Manning, Anita.
1987 "Self-Study: How One Museum Got a Handle on Collections Management," Museum News, pages 61-67. Washington, D.C.: American Association of Museums, Volume 65, Number 6.

National Park Service
1985 Cultural Resources Management Guideline, NPS-28 (Release No. 3), A Manager's Guide and Technical Supplement, Chapter 8. Washington, D.C.: National Park Service.

National Park Service
1991 Natural Resources Management Guideline, NPS-77, Chapter 5. Washington, D.C.: National Park Service.

Weil, Stephen E.
1982 "MGR (Methods/Goals/Resources) A Conspectus of Museum Management." Washington, D.C.: American Association of Museums, Museum News, Volume 60, Number 6.

5. Planning for Park Museum Collections

Hitchcock, Ann
1989 "Museum Objects: Another Endangered Species?" International Perspectives on Cultural Parks, Proceedings of the First World Conference (Mesa Verde National Park, Colorado, 1984). U.S. National Park Service in association with the Colorado Historical Society.

6. <u>Professional Considerations</u>

Alexander, Edward P.
1979 Museums in Motion, An Introduction to the History and Functions of Museums. Chapter 13, pages 233-248. Nashville, Tennessee: American Association for State and Local History.

Committee on Ethics
1978 Museum Ethics, A Report to the American Association of Museums. Washington, D.C.: American Association of Museums.

International Council of Museums (ICOM)
1987 ICOM Statutes - Code of Professional Ethics, Paris, France: International Council of Museums.

Office of Government Ethics
1986 How to Keep Out of Trouble, Ethical Conduct for Federal Employees in Brief. Washington, D.C.: Office of Government Ethics.

H. ENDNOTES

1. National Park Service, <u>Cultural Resources Management Guideline</u> (NPS-28), Release No. 3, A Manager's Guide, Appendix A: Glossary, P.8. Washington, D.C.: National Park Service, 1985.

2. Excerpted from the following article:
Hitchcock, Ann. "Museum Objects: Another Endangered Species?" <u>International Perspectives on Cultural Parks, Proceedings of the First World Conference</u> (Mesa Verde National Park, Colorado, 1984). U.S. National Park Service in association with the Colorado Historical Society, 1989.

CHAPTER 2. SCOPE OF MUSEUM COLLECTIONS

A. INTRODUCTION

A museum collection is an assemblage of objects, works of art, historic documents and/or natural history specimens collected according to a rational scheme and maintained so that it is preserved, studied, and interpreted for public benefit. NPS Management Policies (Dec 88) state that "the National Park Service will collect, protect, preserve, and use objects, documents, and specimens in the disciplines of archeology, ethnography, history, (includes archives, fine and decorative arts, and historic architecture), biology, geology, and paleontology to aid understanding among park visitors and to advance knowledge in the humanities and sciences."

By delegation, Park Superintendents represent the Director and the Secretary of the Interior in accepting title to and responsibility for museum collections. Acquisition methods for museum objects include: gift, purchase, exchange, transfer, field collection, and loan. The NPS Museum Handbook, Part II, Museum Records, Chapter 2, provides detailed guidance on the legal documents and procedures for each type of acquisition transaction.

The scope of a park's museum collection is determined by the mission of the park as stated in its enabling legislation, presidential proclamation, or executive order. Subsequent legislation may revise a park's mission. Museum objects are a primary source of cultural evidence and scientific information that document and support a park's resource management and interpretive programs. In addition, archeological collections and certain natural history collections are mandated by regulation and policy to be a part of a park's museum collection. National Park Service policy permits and encourages the acquisition of museum objects in accordance with established authorities and procedures, when these objects are clearly significant and useful to a park. The successful implementation of this policy requires sound planning. A Scope of Collection Statement, which defines and limits each park's museum collection, serves this purpose.

B. WRITING THE SCOPE OF COLLECTION STATEMENT

A Scope of Collection Statement is the basic curatorial planning document that is required by policy for all parks. This document is also required for other National Park Service organizational units that acquire and maintain museum collections. Parks that do not have a museum collection or that do not intend to acquire museum objects must submit a brief Scope of Collection Statement stating this position. The Scope of Collection Statement must be prepared as an independent document. However, it should be referenced in each park's General Management Plan, Statement for Management, Resources Management Plan, Interpretive Prospectus, and other planning documents that may affect the collection of objects and specimens or their management and use.

The Scope of Collection Statement guides a park in the acquisition of those museum objects that contribute directly to the understanding and interpretation of that park's themes, as well as those additional objects that the Service is legally mandated to preserve. It evolves from legislation and planning documents specific to each park and from laws, regulations, and NPS policies governing archeological research and specimen collection conducted within park boundaries. A properly written Scope of Collection Statement provides the following information:

1. Defines the purpose of a park's museum collection and sets agreed-upon limits that specify the subject matter, geographical location, and time period to which the collection must relate.

2. States what types of objects will be acquired to fulfill the purpose of the park's museum collection.

3. Considers the uses to which the collection will be put.

4. Briefly outlines policy and procedures for the acquisition, preservation and use of museum collections.

Each Scope of Collection Statement includes a Title Page and the following six sections: Introduction, Types of Collections, Acquisition, Uses of Collections, Restrictions, and Management Actions. **The Introduction and Types of Collections are the most important and detailed sections because they establish the purpose of a park's museum collection and describe the types of objects that will be collected.** The information in these two sections ensures logical growth in a museum collection while guarding against obligating the National Park Service to preserve, in perpetuity, objects that are not clearly relevant to a park.

1. <u>Instructions for Writing a Scope of Collection Statement</u>

   The specific content to be included in each section follows below. Refer to Appendix E for examples of Scope of Collection Statements.

a. **Title Page**

Prepare a title page. Spell out the full name of the park (e.g., Mesa Verde National Park). The Title Page also serves as the review and approval page for each Scope of Collection Statement. Figure 2.1 illustrates the proper format for the Title Page. A table of contents is optional, but helpful.

b. **Introduction Section**

This section defines the purpose of the museum collection. Justify the collection by discussing pertinent elements of the park's legislation, other mandates, and approved resource management and interpretive planning documents.

Begin by stating the purpose of the park's Scope of Collection Statement. Reference the legal mandate for the Service to acquire and preserve museum objects: Antiquities Act of 1906 (16 USC 431-433), Organic Act of 1916 (16 USC let. seq.), Historic Sites Act of 1935 (16 USC 461-467), Management of Museum Properties Act of 1955 (16 USC 18f), and Archaeological Resources Protection Act of 1979 (16 USC 470aa-mm). State the park's mission. Cite the park's enabling legislation and any relevant subsequent legislation. Include excerpts. If applicable, note that the legislation for the park requires the establishment and maintenance of a museum collection.

The purpose for a park's museum collection can be stated by referring to several planning documents, including the park's General Management Plan, Statement for Management, Resources Management Plan, Interpretive Prospectus, Statement for Interpretation, Historic Furnishings Report(s), exhibit plan(s), or other relevant planning documents. Study interpretive planning documents. Relate how the museum collection supports the park's interpretive program. List the interpretive themes and periods. If they exist, cite the park's Interpretive Prospectus and other interpretive plans. Include title(s) and approval date(s). Study the park's resource management planning documents, and, where relevant, relate how the museum's collection supports the park's resource management program. List pertinent resource management goals and objectives. If they exist, cite the relevant resource management plans. Include title(s) and approval date(s).

The purpose for the park's museum collection also includes managing objects that the Service is mandated to preserve. By policy, archeological collections and associated data acquired as a result of systematic investigation within a park's boundary must be managed intact as part of the park's resource

NAME OF PARK

SCOPE OF COLLECTION STATEMENT

Prepared by:	Title	Date
Recommended by:	Park Superintendent/Site Manager	Date
Concurred by:	Regional Curator	Date
Approved by:	Regional Director	Date

Figure 2.1 Title Page Format for Scope of Collection Statement

and, therefore, <u>never</u> can be outside a park's approved Scope of Collection Statement. Suggested wording for this statement is as follows:

> Archeological materials, except inalienable and communal property, recovered from within park boundaries through systematic collection are National Park Service property and must be retained in the park's museum collection in accordance with <u>43 CFR 7.13</u> and NPS <u>Management Policies</u> (Dec 88).

In addition, certain natural history specimens that are in a NPS museum collection in compliance with <u>36 CFR 2.5</u>, cannot be outside a park's approved Scope of Collection Statement. Suggested wording for this statement is as follows:

> <u>36 CFR 2.5(g)</u> states that specimen collection permits issued by the Park Superintendent must contain the following conditions: (1) Specimens placed in displays or collections will bear official National Park Service museum labels and their catalog numbers will be registered in the National Park Service National Catalog, and (2) Specimens and data derived from consumed specimens must be made available to the public and reports, and publications resulting from a research specimen collection permit shall be filed with the superintendent.

List other laws, regulations, directives, and conventions that are pertinent to the acquisition of museum collections. Refer to Appendix A for a list and brief description of potentially applicable documents. Suggested wording is as follows:

> Other laws, regulations, directives, and conventions, pertinent to museum collections at (park's name) include: the Endangered Species Act of 1973, as amended (16 USC 1531-1543); the Bald Eagle Protection Act of 1940 (16USC 668a); the Migratory Bird Treaty Act of 1918 (16 USC 703-711); the American Indian Religious Freedom Act of 1978 (42 USC 1996); NPS Special Directive 87-3, Conservation of Archeological Resources; the 1983 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and the 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property (implemented in the United States by P.L. 97-446 in 1983, 19 USC 2601).

> If applicable, identify any special designations (e.g., Man and Biosphere Reserve, National Historic Landmark, World Heritage Site) that may be relevant to the park's museum collection.

c. Types of Collections Section

This section, the essence of the Scope of Collection Statement, identifies in some detail the specific types of museum objects that the park acquires to meet the purpose stated in the

Introduction Section. Describe what should be collected to meet the park's enabling legislation, any subsequent legislation, and approved resource management and interpretive goals and objectives, as well as, mandates relevant to archeological and natural history collections.

Begin with a statement that indicates that the Introduction Section states the purpose of the park's museum collection. As appropriate, subdivide the two major categories of museum collections, natural history and cultural collections, into specifically defined disciplines (e.g., biology, geology, and paleontology, archeology, ethnography, history). Subdivide each appropriate discipline into collecting categories that reflect the purposes of the park. The collecting categories may be based on classification, time period, themes, or other criteria. See further discussion of natural history and cultural collections below.

Briefly describe current representation of object types under each collecting category and discuss strengths and deficiencies of the existing collection. Identifying deficiencies will help to define priority areas for active collecting. Provide sufficient detail in order to allow discrimination among the various types of objects that may be considered for acquisition. To the extent possible, establish quantitative limits on the collection.

Include all archeological and certain natural history objects (e.g., those retained for permanent collection or exhibit) collected within park boundaries because they are NPS property and must be retained in the museum collection according to law, regulation, and policy. Also state the requirement to retain all records associated with archeology and natural history collections. These records include field notes and catalogs; daily journals; drawings and maps; photographs and negatives; slides; sound recordings; raw data sheets; instrument charts; remote sensing materials; collection inventories; analytical study data; conservation treatment records; computer documentation and data, and reports. All such records are retained and managed as part of the park's museum collection.

1) Natural history collections. These collections contain materials from the following disciplines: biology, paleontology, and geology. Development of a natural history collection should proceed in close coordination with park resource management and interpretive staff, as well as with regional curators, natural resource scientists, and chiefs of interpretation. If this category is not applicable, make a statement that the park does not collect or maintain a natural history collection.

   Introduce this category with a brief paragraph that describes a program for the selective acquisition of natural

history specimens. Base this paragraph on appropriate resource management and interpretive goals and objectives. A natural history collection may include representative specimens found in the park, voucher specimens, and environmental monitoring samples. Natural history specimens should be collected selectively so that only well documented and appropriate specimens are retained. Include the collecting categories "field records and reports" and "collections by permit" under each discipline. If applicable under Paleontology, include a statement that addresses the park's program to curtail uncontrolled surface collecting by staff and visitors.

2) Cultural collections. These collections contain materials from the following disciplines: archeology, ethnology, and history (includes archival, fine and decorative arts, and architectural materials). In developing a cultural collection, park curatorial staff should work in close coordination with park resource management and interpretive staff, with regional curators, historians, archeologists, and chiefs of interpretation, as well as Native or other peoples who have a personal or cultural affiliation with the collection.

Include an introductory paragraph that indicates the purpose of these collections. Under archeology include collecting categories for "artifacts and specimens" and "associated field records." Under "artifacts and specimens" include a statement that addresses the park's program to curtail uncontrolled surface collecting by staff and visitors. Certain priorities must be used in deciding what history and ethnographic objects should be collected. State that an object from the site or directly associated with person(s) or event(s) commemorated by the park is more desirable than a similar object without such association. Briefly note current representation of object types. Priority must be given to the best documented site-related objects. When a large quantity of an object type is available, priority should be given to acquiring the best preserved examples.

Limiting the growth of history and ethnographic collections is an important consideration. If appropriate, indicate the types of objects that should not be part of the park's museum collection. History and ethnographic collections may be limited to types and quantities sufficient to implement exhibit plans and/or historic furnishing reports. If a history or ethnographic research/study collection is deemed to be important to fulfilling the park's mission make such a statement. Justify this collection by referencing appropriate resource management goals and objectives.

Documents and photographs in a park's administrative files may be transferred to the museum collection. These records

document the efforts to preserve the site or structure and to its establishment and development as a National Park Service area.

Library collections do not have to be mentioned in a Scope of Collection Statement. As a matter of Service policy, these collections are not considered to be a part of a park's museum collection. However, it is appropriate to make a statement at the end of the Types of Collections Section that shows the relationship between the museum and library. If references are made to the library collections, make the following statement:

"Library collections are not managed as part of a park's museum collection. Policy and procedures for library collections are outlined in NPS Management Policies, (Dec 88), Chapter 5; NPS-28, Cultural Resources Management Guideline, a Manager's Guide and Technical Supplement."

d. **Acquisition Section**

Describe types of acquisition sources. Acquisition of museum objects must be governed by a park's ability to manage them according to NPS policies and standards. Briefly reference applicable Servicewide policies or standards for the acquisition and preservation of museum objects. State that museum objects must be acquired, accessioned, and cataloged in accordance with the NPS Museum Handbook, Part II, Museum Records. State that with the exception of field collections, all proposals for acquisition of firearms and ammunition must be reviewed by the Regional Curator as required by NPS-44, Personal Property Management Guideline, Chapter 10. In addition, state that the acquisition of firearms included on the Alcohol, Tobacco, and Firearms (ATF) Bureau's list of prohibited/restricted weapons requires concurrent review by the Regional Curator and the Regional Law Enforcement Specialist. State that NPS policy discourages gifts with limiting conditions. Make a statement regarding delegation to the park superintendent of the responsibility for accepting title to museum collections and for their subsequent management. As appropriate, outline any park-specific acquisition procedures that supplement the Servicewide requirements. Suggested wording for this section is as follows:

Acquisition Section

The park acquires objects for its museum collections by gift, purchase, exchange, transfer, field collection, and loan. Acquisition of museum objects is governed by the park's ability to manage and preserve them according to NPS Management Policies, (Dec 88), Chapter 5, the standards for managing museum objects in NPS-28, Cultural Resources Management Guideline, A Manager's Guide, Chapter 3, the revised Special Directive 80-1 (March 1990), and the NPS

Museum Handbook, Part I. In accordance with NPS policy the park will discourage gifts with limiting conditions. Museum objects must be acquired, accessioned, and cataloged in accordance with the NPS Museum Handbook, Part II, Museum Records. In accordance with NPS-44, Personal Property Management Guideline, Chapter 10, all proposals for the acquisition of firearms and ammunition, except archeological field collections, must be reviewed and approved by the Regional Curator. Acquisition of firearms included on the ATF list of prohibited/restricted weapons requires concurrent review by the Regional Curator and Regional Law Enforcement Specialist.

The Park Superintendent, by delegation, represents the Director and the Secretary of the Interior in accepting title to and responsibility for museum objects. The Superintendent bears the ultimate responsibility for the acquisition and proper care and management of the museum collection. The Superintendent has delegated the day-to-day care of the collection to the (title of position, e.g., park curator, historian).

All permanent acquisitions must receive formal approval from the Park Superintendent before they can be accepted into the museum collection. Upon receipt, all newly acquired objects and related documentation must be turned over to the park curator. The park curator prepares, for the Superintendent's signature, all instruments of conveyance, and letters of thanks, acceptance, or rejection, and transmits these, as appropriate, to the donor, lender, vendor, or other source of acquisition.

e. Uses of Collections Section

Briefly describe the desired and acceptable uses of the museum collection and establish the limits of such uses. Possible uses include exhibits, interpretive programs, research, and other interpretive media (e.g., publications). State that a primary consideration in all uses of museum objects is the conservation of each object in question and the museum collection as a whole.

State the NPS Management Policy regarding the display of Native American skeletal or mummified human remains, grave goods, or other objects considered sacred. State that any interpretive use defined as consumptive (e.g., firing an original rifle or cannon) must be authorized in advance as outlined in NPS-6, Interpretation and Visitor Services Guideline. The use of reproductions is preferred to the consumptive use of original objects. Note specific sections of NPS-28, Cultural Resources Management Guideline that pertain to use (e.g., destructive analysis; research). Suggested wording for this section is as follows:

Uses of the Collection Section

The park's museum collections may be used for exhibits, interpretive programs, research, and other interpretive media (e.g., publications based on museum objects). The governing consideration in the use of museum objects is the conservation of each object in question and the collection as a whole.

In accordance with NPS Management Policies, (Dec 88), Chapter 7, the park will not exhibit Native American disinterred skeletal or mummified human remains or photographs or replicas of them. There will be no display of grave goods or other objects if Native Americans who are culturally associated with them object to such exhibit.

Researchers and other specialists may examine objects and archival materials under the conditions and procedures outlined in the Cultural Resources Management Guideline (NPS-28) and in the park's written procedures for museum collection access. Any interpretive use that may be defined as consumptive must be authorized in advance, as outlined in the Interpretation and Visitor Services Guideline (NPS-6).

f. Restrictions Section

List any restrictions on the museum collection. Restrictions that may be mentioned include, but are not limited to, the following: limited public disclosure of site information for archeological resources and ethnographically sensitive information, limited access to certain objects for security purposes; copyright restrictions on publication of archival and manuscript material and works of art; limited conditions under which endangered, threatened, or rare animals and plants may be collected; and any limiting conditions placed on objects at the time they are acquired. Suggested wording for this section is as follows:

Restrictions Section

NPS Management Policies, (Dec 88), Chapter 5, state "Information regarding the location, nature, and character of archeological, historic, and ethnographic resources may be exempted from public disclosure."

NPS Management Policies, (Dec 88), Chapter 5, state "The identities of community consultants and information about sacred and other culturally sensitive places and practices will be kept confidential when research agreements or other circumstances warrant."

Restrictions may be placed on the publication of images or manuscripts in the museum collection if these materials are

subject to copyright, and this right has not been signed over to the National Park Service.

Because of restrictions in the deed of gift, the park is prohibited from deaccessioning any part of the Adam L. Smith collection (Accession No. AAAA-26) during his lifetime.

All endangered, threatened, or rare plants and vertebrate and invertebrate animals will be collected only when accidentally killed or when dead from natural causes. The collection of threatened, endangered, or rare plant and animal species will comply with NPS Management Policies (Dec 88) and will be in accordance with the provisions of the Endangered Species Act of 1973, as amended, and will be strictly limited according to the applicable rules of the U.S. Fish and Wildlife Service.

g. Management Actions Section

State that the Scope of Collection Statement must be reviewed every two years and revised when necessary in order to remain supportive of and consistent with the park's mission. In addition, state that any revisions to a Scope of Collection Statement must be reviewed by the Regional Curator and approved by the Regional Director.

Identify the need for a Collection Management Plan, if appropriate. Document this need in the park's Resources Management Plan. If this plan has already been prepared, then state this fact along with the completion date. The Collection Management Plan is tailored to assist a park in caring for and preserving its museum collections.

Identify any collections that are stored in a repository outside of the park boundaries, e.g., an NPS archeological or preservation center, another park, or a non-NPS repository. If this situation exists, state the name of the repository and its location.

Suggested wording for this section might be as follows:

Management Actions Section

This Scope of Collection Statement must be reviewed every two years and, when necessary, revised to remain supportive of and consistent with any changes in the park's mission. Any revision to this document requires the approval of the Regional Director.

The park requires a Collection Management Plan. This need is identified in the park's Resources Management Plan. (Refer to 10-238 Package Number and RMP project number.)

Except for objects on exhibit in the museum, all archeological materials and permanently retained natural history specimens collected within the park's boundaries are located at a repository (repository name and location) for proper storage and preservation.

2. Preparation and Approval

The individual assigned curatorial duties at the park or unit level usually prepares the Scope of Collection Statement. Following review by the Park Superintendent or Manager, a draft is forwarded to the Regional Curator for review. Comments are returned to the park for consideration. After review and upon recommendation by the Park Superintendent or Manager and concurrence by the Regional Curator, the Regional Director approves the Scope of Collection Statement.

In addition to the distribution list outlined in the Technical Supplement for the Cultural Resources Management Guideline (NPS-28), two copies of each approved Scope of Collection Statement are forwarded to the Associate Director, Cultural Resources, WASO, Attention: Chief, Curatorial Services Division; and one copy is forwarded to the Division of Interpretive Planning, Harpers Ferry Center.

3. Biennial Review

The Scope of Collection Statement must be reviewed every two years and must be revised whenever changed conditions clearly alter the mission of a park or when priorities in a specific collecting category have been met. A checklist for evaluating a Scope of Collection Statement is included in Appendix E. **Any changes made to a park's Scope of Collection Statement must be reviewed and approved by the Regional Director.**

C. IMPLEMENTING THE SCOPE OF COLLECTION STATEMENT

The development of an acquisition strategy to fully implement the park's approved Scope of Collection Statement may be useful. This strategy will help the park staff to clearly identify gaps in the museum collection. This strategy also will assist the staff in identifying excess objects not relevant to the scope of a park's collection. There is no standard format for an acquisition strategy. However, the following steps are provided to assist a park staff in preparing an acquisition strategy:

1. Start by assessing the types of objects in the museum collection. Include objects/specimens on loan to other institutions. This assessment will better familiarize the park staff with the disciplines and object types represented in the existing collection.

2. Compare the classes of objects identified in the assessment with the classes of objects identified in the Scope of Collection Statement. This step will begin to identify gaps in the collection. Compare objects in the existing collection with object needs identified in exhibit plans or historic furnishings reports. These plans will help to identify objects that are required for the park's interpretive program.

3. Develop a prioritized list of objects needed for the park's museum collection. One suggested way to organize is to list specific types of objects needed under the disciplines identified in the Scope of Collection Statement. The park staff might consider the following criteria in prioritizing needs:

    a. Acquiring objects to replace those borrowed from other parks.

    b. Acquiring only those objects that have a strong relationship to the mission of the park and the purpose of the collection as stated in the Scope of Collection Statement. This criterion includes priorities established by an Exhibit Plan or a Historic Furnishings Report.

    c. Focusing on objects particularly associated with events and activities that took place inside the park's boundaries.

4. Study the park museum files to determine if there are any known sources available to fill identified gaps in the collection. Develop forms to keep records of potential sources of objects for future acquisition by the park. See Figures 2.1, 2.2, and 2.3 for sample forms that may be used by a park to record collections available for acquisition. These forms are neither standardized nor issued centrally. Parks may photocopy these forms and use them as is or develop their own park-specific forms.

    Provide copies of the developed form to staff at public contact locations in order to facilitate the recording of the availability of objects mentioned by visitors. Train the staff in the purpose, use, and disposition of the form.

5. As already stated, archeological and certain natural history collections are generated in response to a park's cultural or scientific resource management requirements and research projects authorized under the Archeological Resources Protection Act of 1979 and 43 CFR 7.13 and under 36 CFR 2.5. The size and scope of these collections is not normally determined by the curatorial staff. However, park staff should work closely with park/regional archeologists/scientists to keep informed on the needs, including potential growth, of these collections.

6. Consider the park's or region's capability to properly manage and care for objects acquired in addition to the existing collections (e.g., consider storage space, conservation, staffing). Contact the Regional Curator for planning assistance.

7. Work through the Regional Curator to receive assistance from the NPS Clearinghouse on locating needed objects for the museum collection. Refer to NPS Museum Handbook, Part II, Chapter 2, for guidance on obtaining the assistance of the NPS Clearinghouse.

8. Establish a park museum object acquisition committee to review and make recommendations to the Superintendent concerning all potential additions by gift, purchase, transfer, exchange, and loan to the museum collection.

9. Use the approved Scope of Collection Statement as the basis for determining what objects in the current collection may not be relevant to the park. Prepare a list of these objects. Work through the Regional Curator to receive assistance on disposing of these unneeded objects.

COLLECTIONS LOCATION RECORD: MUSEUM OBJECTS

NPS Park Unit:______________________________

Use this form to record the location of objects or collections that the park would like to acquire.

Check One:

___Artifacts Contact made by:______________________

___Archival Materials Title:______________________

___Natural History Specimens Contact Date:______________________

Description of the object or collection: discipline(s), quantity, type of object, time periods, condition. Use the reverse if more space is needed.

____

____

____

____

____

______________________________ More on reverse Check here______

Arrangement and organization of collection:______________________

____

Estimated size of collection (cubic feet, shelf feet, quantity, as appropriate):______________________

Qualitative evaluation of the collection (significance):______________________

____

____

Name, address, phone number of owner:______________________

____

____

Current location of collection:______________________

Indicate whether owner is willing to donate, sell, lend, exchange or make the collection available for reproduction and on what terms:______________________

____

Should Park seek future acquisition of items: ____Yes ____No

Native American or other associated Group or Individual to be consulted:

____

Comments:______________________________

______________________________ More on reverse Check here______

Figure 2.2. Sample Form for Museum Objects Location Record

COLLECTIONS LOCATION RECORD: PHOTOGRAPHS AND PAINTINGS

NPS Park Unit:____

Use this form to record the location of photographs or paintings that the park would like to acquire.

Check One:
___Photographs
___Original Art
___Prints/Posters
___Plates/Clippings

Contact made by:______________________
Title:______________________
Contact Date:______________________

Subject(s) covered in collection:______________________________
____

Time period(s) and geographical area(s) covered:______________________
____

Size (quantity) of collection and description of images by size and type, i.e. print, slide, movie film, painting, print, etc.:______________________
____
____

Extent to which items have been identified:______________________

How processed, organized, and stored:______________________
____

If photographs, are negatives available?______________________

Notes:____
____

Name, address, phone number of owner:______________________
____
____

Current location of collection:______________________

Indicate whether owner is willing to donate, sell, lend, exchange or make the collection available for reproduction and on what terms:______________
____

Should Park seek future acquisition of items: ____Yes ____No

Comments:____
____
____

Figure 2.3. Sample Form for Photographs and Paintings Location Record

COLLECTIONS LOCATION RECORD: PUBLISHED AND UNPUBLISHED WORKS

NPS Park Unit:____

Use this form to record the location of published and unpublished works that the park would like to acquire.

Check as Appropriate:
___Book/Monograph
___Serial
___Manuscript/Other Unpublished Work

Contact made by:________________________
Title:________________________
Contact Date:________________________

Describe in as much detail as possible the work or works of interest. List the following in the order given: author, title, edition, place and date of publication, number of pages, and whether the work contains illustrations, maps, charts, photographs, footnotes, appendices, or bibliography. Some information about physical condition is desirable. If the collection is too extensive to list on this form, prepare a separate list and attach it to the form; on this form show a general description of the collection by subject and type of works.

____
____
____
____
____
____
____
____

Arrangement and organization of collection:________________________
________________________Cataloged: Yes____ No____

Qualitative evaluation of the collection:________________________
____

Estimated size of collection (cubic feet, shelf feet, quantity, as appropriate):________________________

Name, address, phone number of owner:________________________
____
____

Current location of collection:________________________

Indicate whether owner is willing to donate, sell, lend, exchange or make the collection available for reproduction and on what terms:____________
____

Should Park seek future acquisition of items: ____Yes ____No

Figure. 2.4. Sample Form for Published and Unpublished Works Location Record

D. ACQUISITION POLICIES AND CRITERIA FOR MUSEUM OBJECTS

1. Acquisition Policies

a. Objects acquired by gift, purchase, exchange, transfer, and field collection must be justified in the park's approved Scope of Collection Statement. Objects not identified in this statement should not be considered for acquisition. Refer such objects to an appropriate agency or institution that has in its goals the collection of such objects. Objects acquired by loan must be justified either in the Scope of Collection Statement or by another park planning document (e.g., Exhibit Plan, Statement for Interpretation, Historic Furnishings Report).

b. Title to all objects accepted as gifts or bequests must be transferred to the National Park Service free of restrictions, legal and valid, as to their use or future disposition. Inform all prospective donors and vendors of this policy prior to completing any transaction.

c. A park unit will knowingly acquire only those objects and specimens that staff has determined, to the best of its ability, to have been collected, exported, imported, transported, or otherwise obtained and possessed in full compliance with the laws and regulations of the country of origin, of the United States Federal Government, and of individual states within the U.S., and to have been collected ethically, responsibly, and in a manner compatible with professional disciplines and museum standards.

   A park will not support illicit trade by acquiring, authenticating or commenting upon collections, or participate in transactions involving any collection by any museum or private person or institution that knowingly does so. Suspect materials must be reported to the Superintendent and Regional Curator. If a park should inadvertently acquire an object that is later determined to have been collected, exported, imported, transported, or otherwise, obtained in violation of this policy, the park will make every practicable effort to return the object or objects to the rightful owner.

   Such objects found in park collections will be brought to the attention of the Park Superintendent and Regional Curator.

d. A donor is entitled to claim the value of a gift to the park's museum collection within current tax laws. The proper amount that can be deducted is solely a matter between the donor and the U.S. Internal Revenue Service. Park staff should not become involved in this matter. See Section E of this chapter for guidance on appraisals.

e. As a general practice, the Service does not purchase archeological or natural history collections. Each park unit should develop a written procedure to be signed by the superintendent regarding

staff field collecting. A park's staff field collecting procedures should include:

1) Brief background on field collecting activity in the park. Cite any pertinent legislation.

2) Procedures for both cultural and natural science collections.

3) Circumstances under which staff may collect archeological materials. Cite 43 CFR 7.13, NPS Management Policies (Dec 88), and NPS-28. Such circumstances may include:

   - Objects discovered during ruins stabilization, structure treatments.

   - Surface collecting - when perishable and other important objects are discovered and are determined by Park Service archeologist to be in imminent danger.

   - Objects collected as a result of authorized research.

4) Circumstances under which staff may collect natural science materials. Cite 36 CFR 2.5 and NPS Management Policies (Dec 88). Such circumstances may include:

   - Objects collected as a result of authorized research (e.g., collections needed permanently to document the park's resource base).

   - Surface collecting - when fragile/perishable fossils are discovered and are determined by a paleontologist to be in imminent danger.

   - Objects collected for specific interpretive purposes (e.g., exhibits).

   - Objects acquired under unusual circumstances (e.g., road kills).

5) Staff responsibilities and procedures for these collections.

f. Large archival/manuscript collections represent a correspondingly large investment in staff time, budget and space in order to provide proper care and access. Acquiring and maintaining such a collection entails the responsibility to preserve, organize and make it available for use by researchers. Contact the Regional Curator prior to declining the acceptance of an archival collection. Acquisition of such collections must meet the following criteria in accordance with NPS Management Policies (Dec 88):

1) The collection must be justified by the park's Scope of Collection Statement.

2) Adequate storage facilities can be provided in the park or region, to ensure the preservation of original documentary materials in accordance with current curatorial standards.

3) The park's facility is staffed by at least one archivist, curator, librarian, or other person with training or experience in the care and preservation of documentary materials.

4) The collection will be made available to serious researchers under conditions that will maximize both preservation and use and will ensure proper security against theft and vandalism.

A park that cannot meet the last three criteria should not acquire the collection. However, a park should try to maintain contact with the ultimate acquirer, because information inherent in the collection may be pertinent to the park's resource management and interpretive programs. If the collection is offered as a gift, and the last three criteria cannot be met, the park should not accept the collection, but make an effort to have it placed by the prospective donor in an appropriate local repository such as a public or university library, or historical society.

2. <u>Copyright Considerations</u>

The Copyright Law of 1976 (Title 17, US Code) which became effective on January 1, 1978, governs the exercise of literary rights on published and unpublished writings as well as paintings, sculpture, audiovisuals, pictures, graphics and other media of expression. It should be noted that neither titles nor facts nor ideas, nor blank forms can be copyrighted. Therefore, no permission is required to cite a collection as a source or to use facts from it.

When acquiring archives, manuscripts, sound recordings, works of art or photographs, it is important to know that they are, from a legal point of view, a very special type of museum property. Each item in this category represents two separate and distinct types of property that must be acquired separately: the physical property (e.g., the document itself) and the intellectual property (e.g., the literary rights).

The three categories of possession are as follows:

a. Physical Custody is actual physical possession. A loan collection is in the physical custody of the borrower. The rights and privileges of the borrower depend on any agreement made with the lender who remains the owner.

b. Physical Ownership is the legal title to the tangible property. The rights and privileges are complete as far as the physical property is concerned. The owner can keep it, sell it, bury it, or give it away, but cannot publish it without ownership of the copyright.

c. Copyright Ownership is the ownership of the intangible literary rights. Physical ownership does not automatically carry with it the literary rights and vice versa. The following example illustrates this point:

- A sends a letter to B
- A owns the literary rights to the letter
- B owns the letter itself
- B cannot publish the letter without permission from A
- A cannot gain access to the letter without permission from B

Literary rights include all of the following:

- The right of first publication
- The right to produce derivative works based on the copyrighted work such as later editions.
- The right to restrict copying or quotation.
- The right of public display, in the case of graphics, artistic and diagrammatic works (not manuscripts).

Procedures for obtaining copyright in a gift, purchase or exchange transaction are outlined in the NPS Museum Handbook, Part II, Museum Records, Chapter 2.

3. Acquisition Criteria

If the acquisition of an object or objects is justified by a Scope of Collection Statement, a park unit may reserve the right to accept or reject objects on the basis of the following criteria:

a. Are objects site-specific?

Objects original to a park unit as determined by the Scope of Collection Statement are given first consideration for acquisition over non site-specific objects. Objects related to the themes or periods of a park, but not original to the site, are considered next in priority.

Decisions made concerning the acquisition of non site-specific objects are based on their significance to the park's interpretive and resource management programs and on such factors as authenticity. Reproductions are considered non- site-specific objects.

b. Physical Condition - Is the object intact? Are all parts present? Is there evidence of deliberate or accidental damage (e.g., paint spilled on an object)? Does the object show signs of abuse or neglect (e.g., axe was used for prying or hammering; tool edges worn beyond capability of sharpening them)? Is object made of materials that are inherently unstable (e.g., cellulose nitrate negatives)?

c. Rarity - If an object is considered rare, it may be advisable for the park to accept a donation regardless of defacement, damage, or incompleteness or the quantity of a class of object already in the collection. This criterion is particularly important when considering site-specific objects.

d. Availability - Except for objects original to the park, the curatorial staff should take advantage of the availability of proposed donations to replace like objects already in the collection that are in poorer condition or of lower quality.

e. Authenticity - Can it be determined that the object is what the donor/seller/field collector purports it to be?

f. Collections Management - Does the park have the resources (e.g., funding, staffing, facilities, equipment) to properly manage the object?

E. DETERMINING THE VALUE OF MUSEUM OBJECTS

In the National Park Service, the highest value for museum collections in all disciplines is placed on their association with persons and events commemorated by a park, by their information value to archeological and natural science research, or by their heritage value for traditionally associated people and communities. However, assigning monetary values to objects is necessary under several circumstances: before outgoing loans or exchanges, in order to designate controlled museum property and to justify collection management actions to protect and preserve the collections. When arranging for an outgoing loan, park curatorial staff must determine the replacement value so that the borrowing institution can arrange for adequate insurance protection. For an exchange between the NPS and outside institutions, written appraisals are required to document that the exchange is equitable. Awareness of object values in park collections is necessary in order to identify which objects should be designated as controlled property. Park managers may need to know a park's total collection value in order to justify increased funding, determine responsibility and grade of employees to work with a collection, or assess the level of preservation requirements.

1. Kinds of Values

There are two kinds of values that can be assigned to individual objects: fair market value and replacement value. The purpose of assigning a value determines which kind is used.

a. Fair Market Value is the price agreed to by a willing buyer and a willing seller. When possible, use the fair market value for determining the equity of exchanges. Donors are required to use fair market value to determine value for tax deduction purposes for the Internal Revenue Service.

b. Replacement Value is the amount of money needed to purchase a comparable item at full retail cost. This value is not based on a willing buyer and a willing seller. The owner has no intention of selling the object. This value is appropriate to most situations in a park: identifying value for catalog record, for insurance coverage for an outgoing loan, and for management purposes.

Assignment of either fair market value or replacement value may be inappropriate for certain ethnographic objects of little monetary value but which are attributed with special meaning by a Native American group or other traditionally associated community. Assignment of a replacement value for these items should be limited to outgoing loans and established with full consultation of the particular group.

Note: The cost of conservation treatment for a site-specific irreplaceable object that has been damaged may exceed the fair market value or replacement value. Keep this point in mind when assigning values for outgoing loans.

2. <u>What Makes an Object Valuable</u>

Characteristics that affect object value include: fashion, rarity, condition, age, collection provenience and documentation. English lusterware pottery provides an excellent example of how fashion tempers object value. This late 18th and early 19th century earthenware was popular in its day and became very collectible again in the 1930s and 1940s. In the 1980s, it has not been popular. Therefore, Lusterware's current value is actually less than it was in the 1940s. California Chumash Indian baskets provide an example of how limited supply causes an object's value to escalate. There is only one contemporary weaver alive today. There is an extremely limited supply of historic Chumash baskets. A cherry tavern table offers an example of historic association enhancing object value. This particular table had been used by General Meade as his desk during the Battle of Gettysburg and was signed on the underside by four Union soldiers. Therefore, its historic association makes it worth more money than such a table would be worth otherwise. The condition of an object often affects the value of an object. Missing pieces or visible repairs often decrease value.

3. <u>Determining Value</u>

A specialist assigns a value to an object based on knowledge of the market value and the particular characteristics of the piece. Verification of the date, origin, and uniqueness are crucial when assigning a value. For example, before placing a high value on a chest, an expert determines that the chest was actually made by an 18th century cabinetmaker as opposed to a very similar looking chest made as a Colonial Revival piece during the late 19th or 20th centuries. The value also is affected by period hardware and original or changed structural details.

An accurate fair market or replacement value can usually be placed on objects that frequently appear in auction sales and stores. Furniture, porcelain, gems, basketry, firearms, coins, graphics, jewelry, and books fall into this category. For other objects it is much more difficult to place a valuation because of the less active market. It may be more difficult to place a value on certain objects with site association and certain natural history and archeological objects, like soil and lithic samples, because they possess great historic or scientific value but little or no market value.

4. <u>Assigning Values to Museum Objects Using NPS or Outside Expertise</u>

The purpose and need for knowing an object's value determines whether park staff can assign the value or whether the services of a professional appraiser are necessary. <u>Accurate identification of objects is the first step in being able to assign values</u>. Park curatorial staff can assign approximate values to objects within the collection by conducting research, checking auction catalogs and retail prices, and seeking the assistance of Service experts and

outside museum professionals. Such values are acceptable for registration purposes on catalog records or for loans.

A specialist may be needed when dealing with high value objects, unique objects, objects attributed to famous personalities, or objects of questionable authenticity. A written professional appraisal must also be obtained when arranging an exchange. Refer to NPS Museum Handbook, Part II, Chapter 2 for guidance on exchanges.

A professional appraiser may also be necessary when determining the value of a total collection. In this case, the appraiser classifies types of items in each room, exhibit, or storage area such as kitchenware, furniture, linens, books, archival materials, accessories, silverware, and lighting fixtures, and estimates a value for each category. By totaling these figures, the value of the entire contents of the collection is determined in a relatively short period of time.

a. Using NPS Specialists to Assign Values to Objects

Park curators can contact specialists within the National Park Service to obtain information on the value of specific objects for the purposes of evaluating outgoing loans or to identify controlled property. For example, within the NPS there is a wide range of specialized knowledge of material culture. A few examples of NPS subject matter authorities include specialists in 18th century furniture, experts in military costume, and curators knowledgeable in Native American material culture. Contact the Regional Curator for assistance in locating a Service specialist to assist with determining object values.

Regional Curators should maintain a list of experts to call when valuation information is needed. For instance, an approximate value for a loan may be obtained through a telephone call. Before contacting the specialist, locate as much information on the object's date, description, and condition as is possible. Methods for obtaining information to identify values for museum catalog records include arranging a park visit or sending photographs to a specialist. It is important to remember that a photograph is never as accurate as seeing the original object. For example, a painted finish on a piece of furniture may not be visible in a photograph. Lack of this information may yield an inaccurate value for the object.

Park curators should become more familiar with the replacement and market values for the types of objects in their collections by reading background reference material, examining price guides, and consulting with specialists. Attending antique shows, auctions, and educational forums are some of the ways for park curators to gain this information. Price guides offer replacement value listings for all types of specialized objects like dolls, pewter, glass, furniture, and lighting fixtures. A partial list of price guides is included in Section F. Curatorial staff should

routinely peruse them to obtain a general awareness of the current market values of objects in the collection. Gaining this type of knowledge is crucial to providing the collection with the highest level of documentation and interpretive information. Condition, original materials, and age are principal factors in determining a value, so examine the museum object carefully and match it as closely as possible to those examples given in the guides and to auction sale results.

b. Hiring a Professional Appraiser

A professional appraiser is an individual with acknowledged expertise to establish a monetary value for an object. Professional appraisers must have no interest, monetary or otherwise, in the objects being appraised. Parks may obtain the services of an appraiser any time an appraisal is needed; however, parks should always obtain the services of a specialist in the following situations:

- for objects of extremely high value or questionable authenticity.
- for an exchange with a non-NPS private party or dealer.
- for updating valuations for the entire collection.

Collections can be very specialized. Accordingly, parks should seek out a knowledgeable appraiser in the appropriate discipline area. For assistance in finding and selecting appraisers, parks can contact their Regional Curator, local museum personnel, or a professional appraisal organization. The American Society of Appraisers (ASA) is an international, non-profit independent appraisal organization. The ASA requires written and oral entrance examinations and periodic recertifications. The Society also maintains a directory of certified and accredited appraisers in various designated categories like fine arts, personal property, antiques, and real estate. Several pamphlets about the appraising profession including the "ASA Principles of Appraisal Practice and Code of Ethics" may be obtained by writing or calling:

The American Society of Appraisers
535 Herndon Parkway
Herndon, VA 22070
(703)478-2228

Parks should ensure that only qualified and ethical appraisers are used. Do not hesitate to "interview" potential appraisers and ask about their training, education, specialties, references, and membership in professional associations. Any appraiser selected must have no past, present, or future interest in the transaction and may not be a previous owner or vendor of the object.

Donated appraisal services also may be accepted by a park. Apply the same standards to someone donating services, as to someone being paid.

Services of an appraiser usually include an on-site visit, some research, and preparation of a written report. It is recommended that an hourly rate be paid for services rather than paying a percentage of the total value. Charges based on a percentage of the value tend to encourage a higher value to be placed on the object. Appraisers working with very high value objects are normally justified in charging a rate commensurate with the value of the object. To best use the appraiser's time make the following preparations:

1) determine whether market value or replacement value is needed
2) have the objects physically accessible for viewing
3) provide adequate lighting
4) make accessible relevant information on each object (e.g., documents with provenience information, photographs, or catalog records)

A professional appraiser's written report should include the following information:

1) statement of the kind of value being determined (e.g., fair market or replacement value)
2) name of object and description (If applicable, the description may include dimensions, materials, place of origin, style, condition, date, value.)
3) date of the appraisal
4) statement that appraiser certifies no interest, present, past or contemplated, in the subject property,and that appraisal fee is not contingent upon values certified.
5) signature of the appraiser
6) personal qualifications data on the appraiser

An example of the language that might be included in the description portion of a chair's appraisal follows:

> American (New York), mahogany, Chippendale side chair, claw and ball front feet, cabriole legs, slip seat, vasiform pierced back splat, arched crestrail ending in molded ears, gadroon molding along seat edge, with pine secondary wood, seat 24 x 24", overall height 5', excellent condition, circa 1760, $5,000.

An example of a written appraisal is included in Figure 2.4.

5. <u>Documenting Appraisal Information in Museum Records</u>

Record appraisal information on the appropriate museum records as described in the NPS <u>Museum Handbook</u>, Part II, Museum Records,

Chapter 3. The proper place to document values obtained for accountability purposes is in the blocks entitled "Value at Acquisition, Basis" and "Current Value, Date, Basis" on the Museum Catalog Record (Form 10-254 and 10-254B). Written appraisals, like those completed for exchanges or obtained by donors before the park received the object, should be kept in the appropriate accession or catalog folder.

6. <u>When to Re-Appraise Objects</u>

Continual fluctuations in the antique and fine arts market mean that values assigned to museum objects do not remain current. Silver is an example of a material whose value drastically fluctuated from 1980, when it reached its peak at $40 an ounce, to 1985, when its price dropped to $5.00 an ounce. The most desirable goal is to periodically re-examine values assigned on catalog records so that they are up-to-date. This is particularly important in the event of theft, because the value listed on the catalog record will determine the type of police investigation and whether criminal prosecution charges are pressed. Curatorial staff should be in tune to particular price fluctuations in "trendy" objects and change values on their catalog records accordingly. For example, the 1980s interest in dolls has caused their prices to surge beyond anticipated price increases.

7. <u>Appraisals Required for Purpose of Tax Deduction</u>

NPS employees are prohibited from providing appraisals for tax deduction purposes. Staff should not refer donors to specific appraisers in order to obtain a valuation for tax deduction purposes. Parks may assist donors by informing them of the IRS law requiring the appraisal and referring them to additional information. Park staff need to keep abreast of IRS regulations (26 CFR, Part 1) concerning donated property. Park staff should obtain a copy of the American Association of Museums publication <u>Gifts of Property, A Guide for Donors and Museums</u> (listed in Section F). This brochure provides guidance on the current IRS regulations (26 CFR, Part I) relevant to charitable contributions of property.

To obtain a charitable tax deduction, donors of similar items of property with an aggregate value exceeding $5,000, must obtain a qualified appraisal and attach an appraisal summary to the tax return on which the deduction is claimed. The Internal Revenue Service provides a summary appraisal form entitled "Noncash Charitable Contributions Appraisal Summary" Form 8283. The Tax Reform Act of 1984 (Public Law 98-369) set forth revisions to 26 CFR, Part 1 and also issued guidelines on what consitutes a qualified appraisal and a qualified appraiser.

The 1984 Tax Reform Act requires that museums acknowledge the receipt of donated property valued above $5,000 by signing the appraisal summary, Form 8283. The signing of the appraisal summary does not require parks to confirm or agree with the values assigned. Museums

are also expected to file IRS Form 8282 "Donee Information Return" if the gift is disposed of within two years after the contribution date. Send copies to the donor of all forms that the park files with the IRS. If requested, parks must provide the IRS with information on the donor and the donated property. There is a maximum penalty of $50 for failure to provide this information. Maintain copies of all forms filed with the IRS for a particular donation in the appropriate accession or catalog folder.

June 7, 1988

William Morris, Appraiser
American Society of Appraisers 263 Market Street
Philadelphia, PA 19097

Re: Report for Louis XVI National Historic Site
Ipswich, MA

The following is a list of museum objects which I inspected at your park on June 3, 1988. I have carefully examined each item, and, in my judgement their current replacement values are as follows.

<u>Furniture</u>

English Mahogany Secretary Bookcase, brackett feet, 3 long drawers below 3 short drawers, fitted interior with satin-wood fronts, two glass bookcase doors with V-shaped glass divisions, arched cornice, Circa 1790 - 44"w x 93"h	$ 8,500.00
Mahogany Hepplewhite style Flip Top Dining Table, reproduction, 60" x 36"	645.00
Pair of French Walnut Regency style Round Tables, marble top, shelf below, 36" dia. Circa 1900	1,500.00

<u>Sterling Silver</u>

Stuffing Spoon, feather edge, Old English Pattern - Beaver Crest Hallmarked - London 1810	325.00
Pair of Salt Spoons, Fiddle Pattern, Hallmarked London 1810	150.00/pr.

The foregoing appraisal is made with the understanding that the appraiser assumes no liability with respect to any action that may be taken on the basis of this appraisal.

The appraiser hereby certifies that he has no interest, present, past or contemplated, in the subject property, and that his fee for this appraisal is not contingent upon the values certified.

Yours very truly,

William Morris

Attachment: Appraiser Qualifications vita

Figure 2.5. Sample of Written Appraisal

F. SELECTED BIBLIOGRAPHY

Scope of Collections/Acquisition Policies

Alexander, Edward P.
1979 Museums in Motion, Chapter 7--"The Museum as Collection," pp. 117-138. Nashville, TN: American Association for State and Local History.

Guthe, Carl E.
1982 The Management of Small History Museums, pp. 21-31. Nashville, TN: American Association for State and Local History.

Lee, Welton L., Bell, Bruce M., and Sutton, John F. (edited by)
1982 Guidelines for Acquisition and Management of Biological Specimens. Lawrence, Kansas: Association of Systematics Collections.

Malaro, Marie C.
1979 "Collections Management Policies," Museum News, pp. 57-61. Washington, D.C.: American Association of Museums.

McCree, Mary Lynn
1975 "Good Sense and Good Judgement: Defining Collections and Collecting," Drexel Library Quarterly 11, pp. 21-33.

Nicholson, Thomas D.
1983 "The Obligation of Collecting," Museum News, pp. 29-33. Washington, D.C.: American Association of Museums.

Porter, Daniel R.
1985 "Current Thoughts on Collections Policy," Technical Report Number 1. Nashville, TN: American Association for State and Local History.

Assigning Values/Authentication

American Association of Museums and Association of Art Museum Directors
1986 Gifts of Property, A Guide for Donors and Museums. Washington, D.C.: American Association of Museums.

MacLeish, A. Bruce and Guldbeck, Per E.
1985 The Care of Antiques and Historical Collections (Second Edition: a fully revised and greatly expanded edition by A. Bruce MacLeish), Chapter 1--"The Artifact and It's Documentation," pp. 5-18. Nashville, TN: American Association for State and Local History.

Malaro, Marie C.
1985 A Legal Primer on Managing Museum Collections, Chapter XIII--"Appraisals and Authentications," pp. 251-268. Washington, D.C.: Smithsonian Institution Press.

The following publications may be helpful in assigning values to objects:

Warman's Antiques and Their Prices, Warman Publishing Company, Willow Grove, Pennsylvania (Revised Annually)

Kovel's Antiques and Collectibles Price List, Crown Publishers, New York (Revised Annually)

Knopf Collectors Guides to American Antiques, Alfred A. Knopf, New York (There are individual volumes covering furniture, glass, dolls, quilts, pottery and porcelain, silver, toys, and folk art)

CHAPTER 3. MUSEUM OBJECTS PRESERVATION: GETTING STARTED

<u>Page</u>

A. INTRODUCTION TO MUSEUM OBJECTS PRESERVATION

The survival of a collection and its continued use in exhibition and research depends on a museum's long-term commitment to preserving its objects. The obligation of a museum to preserve its collections is clearly stated by Ralph H. Lewis:

> "Museums gather objects of many kinds. Some of these, such as the Liberty Bell, Washington's inaugural costume and the artifacts of the English settlers at Jamestown, have transcendent importance in themselves. Others are simple everyday objects which reflect aspects of the past. Still others record and verify research. All are alike in requiring constant care to preserve them. Metals corrode; paints, dyes and inks fade; cloth, hides and wood are subject to insect and rodent attack; and many other hazards threaten the survival of museum specimens. None will last forever, but with proper attention you can enable specimens to endure for centuries to come. It is the obligation of a museum to make sure that they receive this care."[1]

In the museum field, conservation is the technology of preserving collections. Conservation of museum objects is consistent with the National Park Service's mandate to preserve natural and cultural resources for present and future generations. The term <u>object conservation</u> refers to the measures taken to prolong the life of an object. NPS definitions of preservation and object conservation are included in the glossary of this chapter. NPS policies for the treatment of museum objects, as excerpted from the NPS <u>Management Policies</u> (Dec 1988), are included in Appendix A.

The primary goal of museum object conservation is to **preserve objects in as stable a state as possible.** In the National Park Service, object conservation is an ongoing process of <u>preventive conservation</u> supplemented by <u>conservation treatment</u> when necessary.

1. <u>Preventive Conservation</u>

The goal of preventive conservation is to prevent harm to an object before it occurs. When a ceramic vase crashes to the floor because its exhibit mount fails or because it is dropped through carelessness, preventive conservation has failed. However, preventive conservation is not only about avoiding accidents. It is based on the realization that deterioration also occurs slowly over decades. Each incident of wear may hardly be noticeable, but the gradual accumulation finally becomes serious deterioration. For example, an unfavorable environment works imperceptibly on an object each day, but the cumulative effect, over years, is serious deterioration. Preventive conservation is based on the realization that it is feasible to significantly retard or prevent the serious deterioration of objects caused by improper use, inadequate storage, improper environmental conditions, or accidental destruction.

A preventive conservation program for many park museum collections (especially archeological and natural history collections) also ensures the preservation of <u>the data or data containing residues that are within, on, or associated with the object(s)</u>. Proper maintenance of this material will ensure the capability of relating an object to associated data in the future.

A program of preventive conservation includes maintenance of museum objects and their associated data in a stable environment and ensures proper handling, storage, and exhibit techniques to reduce the rate of deterioration to a minimum. A preventive conservation program will minimize the need for conservation treatment. It is an approach to museum collections management that emphasizes a long-term, ongoing program for the preservation of objects and includes the following elements:

- Knowing the causes and recognizing the symptoms of object deterioration.
- Inspecting objects on a regular schedule.
- Monitoring and controlling the museum environment (e.g., relative humidity, temperature, light, pests, dust and other pollutants).
- Practicing proper techniques for the handling, storage, exhibit, packing and shipping of objects.
- Providing appropriate security and fire protection for objects.
- Preparing and implementing, when necessary, emergency management plans for objects.

2. <u>Conservation Treatment</u>

Conservation treatment is necessary when preventive conservation measures are not enough to reduce the rate of deterioration to a tolerable level, when deterioration has proceeded to a point where the object is extremely fragile and is in danger under any circumstances, or when required for exhibit or research.

The use of the word "conservation" (and "conservator") reflects a changing emphasis in the treatment of museum objects. In the past, "restorers" worked to renew the appearance of objects, and often, the retention and preservation of original or historically important elements was not a high priority. Today, the preservation aspects of conservation treatment receive increasing attention. Often, "conservators" devise treatments primarily to <u>stabilize</u> the condition of museum objects. There may be little or no "restoration." The word "restoration" refers, specifically, to efforts to return an object, as nearly as possible, to its original appearance, or to its appearance in a particular historic period, by removing accretions, subsequent additions and by replacing missing elements.

In the National Park Service, all treatments are kept to a minimum to reduce the possibility of compromising the archeological, historic, scientific, or aesthetic integrity of objects. Emphasis is placed on preserving the original materials and on minimizing restoration. For all conservation treatments, the Service adheres to the Code of Ethics and Standards of Practice of the American Institute for Conservation of Historic and Artistic Works. A copy of this Code of Ethics is included in Appendix D.

B. ESTABLISHING AN OBJECT CONSERVATION PROGRAM

1. Responsibility for Museum Object Conservation

Conservation of museum objects is a shared responsibility between the curator and the conservator. The curator is responsible for the day to day management of the museum collection, including acquisition, record keeping, preventive conservation, interpretation and exhibits, research and publication. Often, the curator is a specialist in a discipline (e.g., archeology, biology, history, fine arts) related to the collection. The conservator is trained and skilled in the theoretical and practical aspects of preventive conservation and of performing treatments necessary to preserve an object's historic, scientific, and aesthetic value. Most conservators specialize in the treatment of a specific class of objects (e.g., paintings, furniture, books, paper, textiles, metals, ceramics and glass, photographs, archeological, and ethnographic objects, or natural history specimens).

A cooperative relationship between the curator and the conservator is crucial to the successful conservation management of a park's museum collection. Mutual understanding and respect for each other's role and responsibilities to the collection is essential. Curators should recognize that conservation treatments are the responsibility of a conservator or a trained conservation technician. Curatorial staff, unless properly trained in the required techniques, should not attempt repairs or perform other interventive treatments on objects. Conservators should recognize that the curator is ultimately responsible for making judgements about the care and management of the collection. The roles of the curator and the conservator in museum object conservation management are illustrated in Figure 3.1.

2. Curatorial Supplies, Equipment, and Technical Assistance

The NPS Museum Handbook, Parts I and II, identify a wide variety of blank forms and specialized supplies and equipment that are needed for managing park museum collections. A useful companion to the handbook is NPS Tools of the Trade. This publication, prepared and distributed by the Curatorial Services Division, Washington Office, is a catalog of curatorial supplies and equipment, such as museum record keeping materials and forms; storage containers; specialty curatorial items (e.g., white cotton and latex gloves, polyethylene drawer liners); natural history supplies; museum cabinetry, shelving, and racks; and environmental monitoring and control apparatus. Tools of the Trade also contains instructions on how to obtain museum supplies and equipment, and to get answers to questions about storage techniques, special storage requirements, proper use of materials and equipment, and source information for purchasing supplies or equipment. This catalog is periodically updated. Copies have been distributed to all regional offices, parks, and centers. Keep this catalog close at hand for ready reference.

Preventive Conservation

Curator	Conservator
• Monitors amd assesses condition of objects • Monitors and evaluates museum environment • Practices proper methods and techniques for storing, exhibiting, handling, packing and shipping of objects • Develops and implements ongoing housekeeping/maintenance program for collection • Prepares emergency management plan for museum collection	• Assesses condition of objects; conducts Collection Condition Surveys • Alerts staff to signs and causes of deterioration • Provides technical guidance on museum environment, storage, exhibits, handling, packing and shipping • Assists in development of housekeeping/maintenance programs and in preparation of emergency management plans

Conservation Treatment

Curator	Conservator
• Documents history, significance, value, and proposed use of each object to be treated • Develops and monitors contracts for conservation services • Assesses, in consultation with conservator, the suitability of written treatment proposals and authorizes treatments • Monitors progress of treatment for each object • Ensures continuing care for treated objects	• Examines and documents conditions and problems of objects • Prepares treatment proposals for curatorial review and approval • Performs suitable treatments • Documents treatments performed • Recommends methods for the future maintenance and care of treated objects

Figure 3.1. Curator and Conservator Roles in Object Conservation Management

3. Museum Object Conservation Planning

The conservation of a park's museum collection requires a well-planned program. Remember: Museum object conservation is an ongoing process, not a one-time effort. A well-planned program that ensures the efficient use of funds and available staff time to provide appropriate, long-term care for museum objects includes the following actions:

- Document the collection as required by the NPS Museum Handbook, Part II, Museum Records.

- Conduct a self-evaluation to identify deficiencies. Use the "NPS Inspection Checklist" for Museum Storage and Exhibit Spaces included in Appendix F.

- Implement a preventive conservation program.

- If appropriate, assess the condition and preservation needs of the structure housing museum objects.

- Obtain a Collection Management Plan to assess park's collection management program and to provide specific guidance on improving the care of the collection.

- If appropriate, obtain a Collection Condition Survey of the collection, including examination of objects and assessment of condition and treatment needs. Based on this report and available information regarding use and significance of each object, develop a prioritized object conservation treatment list.

- Identify emergency threats to the museum collection and incorporate appropriate guidance into the park's Emergency Operations Plan and overall Protection Program.

- Prepare programming documents to implement an object conservation program.

- Develop and implement training sessions for park staff who handle and work with museum objects.

The Collection Management Plan and the Collection Condition Survey are planning documents designed to assist in establishing and implementing a long-term, ongoing program for the conservation of a park's museum collection. They help parks in budgeting time, funds and staff to address museum collection needs. The usefulness of both of these plans depends on a park's commitment to implementing the recommended actions.

C. THE COLLECTION MANAGEMENT PLAN

1. Purpose and Content

The Collection Management Plan (CMP) assesses a park's museum collection management program to identify problems and makes recommendations to improve the care of the collection. The plan focuses on such curatorial issues as the scope of the collection, museum records, environmental conditions in storage and exhibit spaces; storage space, equipment, and techniques; object conservation treatment needs; housekeeping; security, fire protection, and emergency management concerns; access and use, and staffing and funding. Refer to Appendix F for a detailed outline of the content of a CMP. The plan includes:

- A description of the size and nature of the museum collection
- An assessment of the existing collections management program in light of NPS collections management policies, standards, and procedures
- Specific recommendations, tailored to the park's needs, for correcting any deficiencies identified in the assessment
- Staffing, planning and programming requirements needed to correct deficiencies and to implement an ongoing program for the proper care and management of the museum collection
- Specific technical information (e.g., recommended techniques and procedures, lists of equipment and supplies, floor plans, completed programming documents and position descriptions) to assist the park's curatorial staff

2. Steps in the Collection Management Plan Process

a. Request for the Plan

If a Collection Management Plan is needed, include a project statement for this need in the park's Resources Management Plan. Consult the Regional Curator for assistance in requesting a CMP. Prepare and submit the appropriate programming document (e.g., Development/Study Package Proposal Form 10-238) to the regional office. Refer to Chapter 12 of this handbook for guidance on programming and budgeting for museum collections management.

b. Selection of the Planning Team

For objectivity and diversity of views, a Collection Management Plan is not prepared by the staff of the subject park. The plan is produced by an individual or team of NPS or contract museum professionals with expertise appropriate to the nature and needs of the park's collections. The team is generally made up of curators or collection managers (GS-9 and above) and may include

conservators. The Regional Curator often assists with the plan. The Collection Management Plan is based on information gathered by the team during a site visit. Throughout the planning process, the team works closely with the park staff, the Regional Curator, and as appropriate, other regional specialists.

c. Preparation for the Site Visit

Prior to the site visit, the team reviews numerous park documents to acquaint the members with the park and the history, nature, and current status of the museum collection and its care. The availability of such documents will vary from park to park, and, in many instances, only small sections are relevant to the preparation of the CMP. See Appendix F for a "Checklist of Reference Documents for Collection Management Plan Team." The team will need to have access to the park's museum records (e.g., accession book, catalog records, accession files). The team also will review recorded data on environmental conditions, the park's budget including staffing allocated to collections management, and the park's most recent programming documents (e.g., Request for Base Increase Form 10-237, Development/Study Package Proposal Form 10-238). Park staff also should prepare to raise issues that need to be addressed by the team. The team and the park staff arrange the dates for the visit. The regional office and park are notified by memorandum of the dates of the site visit and the names of the team members.

d. The Site Visit

The team meets with the Superintendent/Site Manager and staff on the first day of the visit. Most site visits last from two to five days depending on the complexity of the museum collection. During the visit, appropriate park staff work with the team members to provide information and access to museum collections. The team meets with the Superintendent/Site Manager and staff for a close-out meeting on the last day of the visit.

e. Preparation and Review of the Plan

Each team of two or more members has a team coordinator. The duties of the team coordinator are as follows:

- Selects team members and plans and schedules site visit.

- Coordinates on-site activity, ensuring that all sections of the CMP are adequately researched and that related activities are thoroughly examined.

- Writes a trip report for region and park that outlines some of the basic findings and any recommendations that should be implemented prior to completion of the CMP.

- Reviews, edits, and compiles draft plans with the cooperation of the team and forwards drafts to WASO, region and park for review and approval.

The duties of each team member are as follows:

- Review all relevant park documents.

- Participate in site visit.

- Write assigned sections and submit drafts to team coordinator by established deadline.

- Make necessary revisions to sections based on comments from WASO, region, and park, as directed by team coordinator.

A first draft CMP is submitted for review by the Associate Director, Cultural Resources, WASO; other WASO divisions and offices, as appropriate; the region; and the park. In response to review comments, a second draft is prepared for final review and approval. Upon recommendation of the Superintendent/Site Manager and concurrence by the Regional Curator, the Regional Director approves the Collection Management Plan.

f. Implementation of the Plan

Implementation of the CMP recommendations may require several years because of the time involved in the programming and budget process. To ensure the Collection Management Plan's relevancy to a park unit, it should be reviewed every five years and updated, if necessary, at that time.

g. Distribution of the Final Plan

Collection Management Plans are distributed to the park, regional office, National Technical Information Service (NTIS), Washington Office Cultural Resources Repository, the Curatorial Services Division, and to others designated by the park and region.

D. THE COLLECTION CONDITION SURVEY

1. Purpose and Content

The Collection Condition Survey (CCS) is a report on the status of object conservation in a park's museum collection. The museum conservation profession calls this report a Collections Conservation Survey. For example, a conservator may be requested to survey a park's collection of historic photographs to determine treatment needs and record baseline data for the future assessment of deterioration. In another instance, a conservator might examine an exhibit to evaluate the displayed objects for signs of deterioration and to evaluate the mounts, lighting, and case design and construction.

A survey is conducted by a conservator specializing in the treatment of the particular objects to be surveyed (e.g., photographs, paintings, furniture, textiles). The survey report may include recommendations pertaining to storage techniques, environmental conditions, pest control, or other related matters. Or, the emphasis of a survey report may be to provide information on the condition of individual objects in the collection.

Over a period of time a park may need several different surveys by one or more conservators, depending on the kinds of objects in the collection, its size, and the park's programs and priorities. Surveys done in conjunction with a Collection Management Plan usually focus on general conditions in exhibit and storage areas and may employ curatorial specialists other than conservators. Conservators, however, are required to conduct surveys that focus on the condition of individual objects. Surveys should address a park's special problems and needs. It is important that guidelines for a survey be determined and clearly communicated to the conservator(s), so that the park obtains a useful report.

In many cases, curatorial staff need assistance in establishing conservation treatment priorities. A Collection Condition Survey can help if it includes the following information:

a. A description of the condition of each object examined.

b. A conservation treatment priority for each object examined. Priorities are often established in several categories, such as:

   1) Object urgently requires treatment to prevent serious damage or loss, or requires immediate improvements in storage or exhibit conditions.

   2) Object requires major treatment.

   3) Object requires minor treatment.

   4) Object requires no treatment.

The treatment needs described by the conservator must be evaluated by the curatorial staff on the basis of its knowledge of the significance and use of each object in order to establish meaningful conservation treatment priorities.

c. A brief description of the type of conservation treatment needed for each object examined.

d. An estimate of the time required for treatment for use in programming and budgeting.

2. Steps in the Survey Process

a. Request for the Survey

Whenever a need for a Collection Condition Survey is identified, consult the Regional Curator for assistance. If appropriate, prepare and submit a programming document (e.g., Form 10-238) to the regional office. Refer to Chapter 12 of this handbook for guidance on programming and budgeting. Ensure that a statement on the need for surveys by conservators is included in the park's Resources Management Plan.

b. Selection of the Conservator(s)

The Collection Condition Survey Report is based on information gathered by a conservator or a team of conservators during a site visit. The survey may be conducted by NPS conservators or by non-NPS contract conservators. The size of a team depends on the number of specific classes of objects to be examined at one time. Conservators conducting a CCS must be specialists in the treatment of the specific class of objects being examined (e.g., furniture, textiles, metals, paper, books, paintings, ethnographic objects, natural history specimens).

c. Preparation for the Site Visit

1) Determine, as precisely as possible, the number of individual objects to be examined in each class of objects and convey this information to the conservator(s).

2) Furnish the conservator with basic catalog information on each object to be examined (e.g., catalog numbers, description).

3) Furnish the conservator with information about prior surveys or prior treatments of objects to be examined.

4) Establish with the conservator the number of days required for the survey. Collection Condition Surveys can be extremely time-consuming.

5) Plan the logistics of the survey. Determine the location where objects will be examined. Assess security needs. Determine work space needs of the conservator (e.g., table, lighting). Identify any equipment requirements (e.g., photographic equipment, ladders, hand tools).

6) Inform the conservator of the conditions of the spaces housing the objects to be examined (e.g., levels of temperature, relative humidity, light; facility deficiencies).

7) Provide general park information to the conservator (e.g., brochure).

d. The Site Visit

The assistance of the park's curatorial staff is essential to the success of the survey and report. The park staff must be able to accompany the conservators to provide information and access to the museum objects to be examined. Before starting the examination, park staff should familiarize the conservator(s) with the collections, with the facility, and the conditions in the storage and exhibit areas. The site visit is an especially valuable time for the conservator(s) to answer questions about conservation practices. At the beginning or at the end of the visit, the conservator(s) and park curatorial staff should meet with the Superintendent/Site Manager.

e. Preparation and Review of the Survey Report

There is no standard format for a Collection Condition Survey. Each report should contain a narrative introduction that provides general information about the site visit (e.g., site name, visit dates, names of conservators) and explains all technical terms. This introduction also may include general recommendations. Either a narrative or checklist format can be used to report each object's present condition. Catalog numbers should be used to refer to the objects surveyed.

The detail in a report varies according to the purpose of the survey. A report on the examination of objects should clearly indicate object type, description, recommended treatment, and whether treatment is urgently needed.

Collection Condition Surveys may include treatment proposals for the park staff's information and guidance. <u>However, these surveys are not intended to provide treatment proposals for other conservators to follow or use</u>. The conservator selected to perform the actual treatment will desire to examine an object or objects thoroughly before submitting a treatment proposal for review and approval. Surveys do provide information for the guidance of curatorial staff in setting priorities for treatment, budgeting, scheduling, and communicating with conservators concerning treatments.

When the conservator(s) provide(s) the park with the designated number of copies of the report, the appropriate staff should review the document immediately. A copy of the report should be forwarded to the Regional Curator. Staff should discuss any questions regarding the report with the conservator(s).

f. Implementation of a Collection Condition Survey Report

A survey and the resulting report are a key step in the park's total object conservation management program. The conservation treatment of objects only should begin when the curatorial staff has identified each object's importance, and present and long-term use. The CCS Report documents the condition of the objects examined and sets priorities for treatment based solely on each object's physical condition and risk. The curator's responsibility is to evaluate the treatment needs in terms of curatorial priorities (e.g., place in park's interpretive and research programs) to develop a program for conservation treatment. Recommended changes in storage and exhibit conditions and techniques can be implemented by the park's curatorial staff.

g. Distribution of Report

Collection Condition Survey Reports are distributed to the park and the Regional Curator, and to others designated by the park and region.

E. THE STRUCTURE THAT HOUSES MUSEUM OBJECTS

The park structure that houses a museum collection very often is of historic significance in its own right, and may have its own preservation needs. In managing museum objects it is important to understand the nature and significance of the structure housing the collection and the problems that the presence of museum collections may create. For example, the environmental needs (e.g., relative humidity and temperature) of museum objects very often differ from the needs of the fabric or envelope of the structure. It is important to keep in mind that modern structures have similar requirements.

The use of a historic structure to house museum objects may impose more wear on the structure than was caused by its original use. In some cases, the installation of museum exhibits or storage areas may impose loads or require physical design changes to the structure in conflict with its original design and historic integrity. Controlling relative humidity levels to museum object standards may cause serious damage to the structure because of condensation within its walls. The <u>installation</u> and <u>operation</u> of modern mechanical, electrical, plumbing, security, and fire detection and suppression systems that may be required for museum collections may pose other serious problems for a historic structure. The presence of collections in the structure's space, physical changes to the structure, and change in its ambiance (e.g., fan noise or machine vibration) must be carefully evaluated.

When the responsible care of museum objects stored or exhibited in a historic structure is expected to require substantial alteration of the structure's fabric by the installation of equipment and systems, the park staff should seek the assistance of other curators, conservators, historic architects, and preservation engineers. Measures implemented to control the environment must be based on data recorded from an ongoing environmental monitoring program. The following factors need to be considered simultaneously in the decision-making process.

- The nature, condition and preservation needs of the museum collection;
- The nature, condition, and preservation needs of the structure housing the museum collection;
- The effects of the planned use (e.g., interpretive programs) on the structure and the museum collections.

An Historic Structures Report (HSR) is required when a major intervention (e.g., environmental control system, intrusion detection system, fire detection/suppression system) is proposed that could affect the characteristics that make a historic structure eligible for inclusion in the National Register. The report needs to address only the issues of intervention. Refer to NPS-28, <u>Cultural Resources Management Guideline</u> for information on an HSR.

F. GLOSSARY

Preservation:	The act or process of applying measures to sustain the existing form, integrity and material of a structure, and the existing form and vegetative cover of a site. It may include initial stabilization work, where necessary, as well as ongoing maintenance. For application to museum objects see definition of object conservation.
Preservation Maintenance	The act or process of applying preservation treatment to a cultural resource. It includes housekeeping and routine and cyclic work scheduled to mitigate wear and deterioration without altering the appearance of the resource; repair or replacement-in-kind of broken or worn-out elements, parts, or surfaces so as to keep the existing appearance and function of a structure; work to moderate, prevent, or arrest erosion of archeological sites; emergency stabilization work necessary to protect damaged historic fabric from additional damage; <u>and actions taken to prevent damage and to minimize deterioration of a museum object by practicing preventive conservation or by performing a suitable treatment on an object itself</u>.
Object Conservation:	In general, conservation refers to the measures taken to prolong the life of a museum object. The primary goal of museum conservation is to preserve whatever still exists of an object as nearly as possible in an unchanging, stable state. In the National Park Service, museum conservation encompasses the following two broad treatments:
Preservation:	The action taken to prevent damage and to minimize deterioration of an object by practicing "preventive conservation" or by performing a suitable treatment on an object itself.
Restoration:	The action that often refers to the attempt to bring an object as close as possible to its original appearance, or to its appearance at a particular time period, by removing accretions, subsequent additions and/or by replacing missing elements.
Preventive Conservation:	That part of the preservation function of object conservation that attempts to prevent harm to an object and the associated data before it occurs.

This function includes actions that monitor and control the museum environment, improve storage and exhibit methods, ensure periodic inspections of objects, ensure proper housekeeping procedures, maintain appropriate security measures, and prevent damage from improper handling and transporting of objects.

Reproduction of Objects: The construction or fabrication of an accurate copy of an object. The object being reproduced may be too deteriorated or fragile to be displayed or otherwise used or may no longer exist. Reproduced objects are normally used as furnishings in historic structures or as equipment in living history programs, but may be used in interpretive exhibits as well.

G. SELECTED BIBLIOGRAPHY

American Association of Museums
1984 Caring for Collections, Strategies for Conservation, Maintenance and Documentation (A report on an American Association of Museums project). Washington, D. C.: American Association of Museums.

Appelbaum, Barbara and Himmelstein, Paul
1986 "Planning for a Conservation Survey." Museum News, 64:3:5-14. Washington, D. C.: American Association of Museums.

Beale, Arthur
1987 "Long Range Conservation Planning for Museums", Conservation Awareness Technical Assistance Leaflet (Winter/Spring). Richmond, VA: Virginia Association of Museums.

de Torres, Amparo R. (Editor)
1990 Collections Care: A Selected Bibliography. Washington, D. C.: National Institute for the Conservation of Cultural Property.

Feilden, Bernard M.
1982 Conservation of Historic Buildings, Chapter 1, pp. 1-22. Stoneham, MA: Butterworth and Company.

Hutchins, Jane Kettel
1987 "Conservation Surveys", Conservation Awareness Technical Assistance Leaflet (Winter/Spring). Richmond, VA: Virginia Association of Museums.

Keck, Sheldon
1973 "A Little Training Can Be a Dangerous Thing." Museum News, 52:4:40-42. Washington, D. C.: American Association of Museums.

National Institute for the Conservation of Cultural Property and Getty Conservation Institute
1990 The Conservation Assessment: A Tool for Planning, Implementation, and Fundraising. Washington, D. C.: The National Institute for the Conservation of Cultural Property.

Ullberg, Alan D. and Lind, Robert C., Jr.
1989 "Consider the Potential Liability for Failing to Conserve Collections," Museum News (January/February), 68:1:32-33. Washington, D. C.: American Association of Museums.

Walters, Jonathan
1989 "Tracking Advances: As Technological Advances in Conservation Occur, Conservators are Developing a New Approach to Their Museum Role," Museum News (January/February), 68:1:44-49. Washington, D. C.: American Association of Museums.

Ward, Phillip R.
1982 "Conservation: Keeping the Past Alive." Museum XXXIV: 1:6-9. Paris, France: United National Educational, Scientific and Cultural Organization (UNESCO).

Ward, Phillip R.
1987 The Nature of Conservation, A Race Against Time. Santa Monica, CA: The J. Paul Getty Institute.

Watkins, Charles Alan
1989 "Conservation: A Cultural Challenge," Museum News (January/February), 68:1-36-43. Washington, D. C.: American Association of Museums.

Welsh, Elizabeth C.
1984 Conservator's Corner: "A Visitor's View of Museum Conservation." Masterkey 58:1:24-25. Los Angeles, CA: Southwest Museum.

H. ENDNOTES

1. Lewis, Ralph H. Manual for Museums, page 62. Washington, D.C.: U.S. Superintendent of Public Documents, 1976.

CHAPTER 4. MUSEUM COLLECTIONS ENVIRONMENT

A. THE AGENTS OF DETERIORATION

From the moment an object is created, it begins to deteriorate because of its interaction with the environment. Deterioration progresses throughout an object's life as a result of the natural and human factors in the environment. Key to the conservation of museum objects is developing an awareness and understanding of the agents of deterioration. The major agents of deterioration are listed in Figure 4.1.

The NPS Museum Handbook, Part I (1967) and the Manual for Museums by Ralph Lewis (1976) considered a number of factors (e.g., environmental, biological, human, and natural) under the heading of "agents of deterioration." This revised Part I of the handbook continues to recognize all of these elements as agents of deterioration. However, each of the above broad categories are discussed in separate chapters. This chapter addresses the environmental agents of deterioration: **temperature and relative humidity, light, and air pollution.** Chapter 5 focuses on the biological agents: microorganisms, insects, and vertebrates. The human factors are covered in Chapters 6 and 9 and natural disasters are discussed in Chapter 10.

Deterioration of museum objects commonly results from adverse environmental conditions. Changes in temperature and relative humidity, and exposure to light, dust, and pollution cause detrimental chemical and physical reactions in objects. Although change may be rapid, it is more often a slow gradual process that occurs throughout an object's life. Slow changes often escape notice by the untrained eye. Objects continually interact with their surrounding environment. The more unfavorable the environmental conditions, the faster an object will deteriorate. The visual effects of environmental action (e.g., temperature, relative humidity, light, air pollution) may not be observed for a long period of time. However, symptoms of deterioration eventually show up. All changes to the condition of an object occur at the molecular level. Certain materials are very stable and tend to resist change (e.g., gold). Other materials tend to be less stable and have a great tendency to change (e.g., iron corrodes easily). The atoms and molecules that comprise an object can be affected by other compounds and various types of energy. Atmospheric moisture can cause corrosion of metals, the warping of wood, and encourage mold growth. Excessive heat may cause certain materials to become embrittled. The visible and ultraviolet components of light can cause many materials to fade. Often materials are affected by several factors at the same time. Rates of deterioration are not constant, but often vary. Certain forms of deterioration may go undetected for many years.

Monitoring and controlling the environmental conditions of museum storage and exhibit spaces and of objects in transit is a key factor in ensuring the long-term preservation of a park's museum collection. NPS policies for environmental monitoring and control, as excerpted from NPS Management Policies (Dec 88), are included in Appendix A. The NPS museum collections environment standard is as follows:

> Museum objects should be housed in a safe, stable environment to reduce their rate of deterioration, prolong their life, and minimize their need for conservation treatment. Relative humidity and temperature are monitored on an ongoing basis and are controlled to minimize fluctuation over short periods of time and to avoid harmful extremes. Light levels are monitored and recorded (including daily and seasonal variations when daylight is involved). Exposure of museum objects to visible spectrum light must be limited in illuminance level and duration. Ultraviolet radiation from daylight and artificial light must be eliminated to the extent possible. Exposure to infrared radiation (heat) from natural and artificial lighting sources must be controlled. Regularly scheduled inspections for evidence of insect and other biological infestations must be carried out. Museum storage and exhibit areas are free of as much particulate matter and gaseous pollutants as is practical.

Refer to the selected bibliography in Section G for additional readings on the environmental agents of deterioration. The book The Museum Environment by Garry Thomson (Second Edition), a standard reference in the museum profession, provides a comprehensive discussion of the principles and techniques of controlling light, humidity, and air pollution in spaces that house museum collections. This book is divided into two parts. Part I provides information about the effects of light, humidity, and air pollution on museum collections and guidance on action to take to minimize the damage caused by these agents. Part II provides scientific information about the effects of light, humidity, and air pollution.

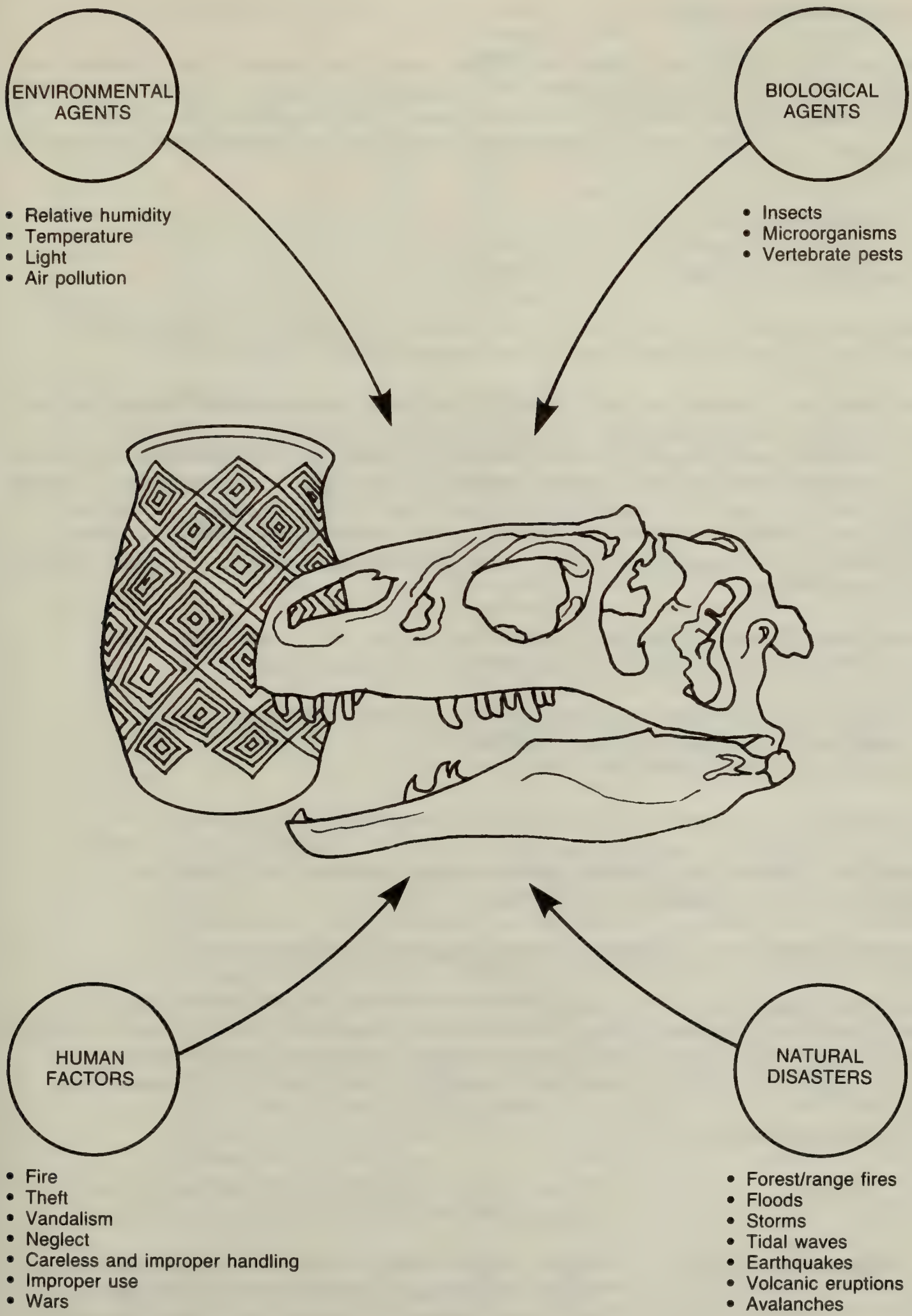


Figure 4.1. The Agents of Deterioration

B. DEVELOPING THE CRITICAL EYE

Evaluating the condition of museum objects and the reasons for changes in condition requires a critical eye. One develops this skill over a period of time through both training and experience. It requires continual inquiry about the status of the museum collection by asking the following questions:

- What is occurring?
- Why is it occurring?
- What does it mean?

This ongoing process of inquiry is an essential step in developing the critical eye. The critical eye is a trained eye.

The trained eye focuses on the object's material make-up and structure and looks for visual clues on how it responds to the natural and human factors of the environment. A trained eye readily recognizes danger signs (e.g., sunlight falling on a light sensitive surface, condensation forming on cold surfaces, water stains appearing on ceilings or walls, sawdust accumulating under furniture), records them, associates them with the condition of the museum collection, and implements actions to slow down or stop deterioration.

Obtaining an awareness and understanding of the following topics is essential for an individual to develop the critical eye:

- Types of materials that comprise a museum collection
- Inherent characteristics of objects
- Types of deterioration

The success of a preventive conservation program relies on the gathering, recording, and evaluating of all this information in order to implement solutions to mitigate environmental factors that are harmful to a park's museum collection.

1. Types of Materials that Comprise a Museum Collection

An understanding of the properties of the materials which comprise an object enables one to take certain actions which will slow or halt the deterioration of that object. Museum objects are divided into three material type categories: organic, inorganic, and composite.

a. Organic Objects

Origin:	Plant (e.g., cellulose) or Animal (e.g., protein)
Material Types:	Wood; paper; textiles; leather and skins; horn, bone, and ivory; grasses and bark, lacquers and waxes, plastics, some pigments, shell, natural history specimens

Characteristics:
- Contain the element carbon
- Combustible at normal temperature
- Made of complicated molecular structures that are susceptible to deterioration from extremes and changes in relative humidity and temperature
- Absorb and emit water vapor from and to the surrounding air in an ongoing attempt to reach an equilibrium (hygroscopic)
- Sensitive to light
- Source of food for mold, insects, and rodents

b. Inorganic Objects

Origin: Mineral

Material Types: Metals, ceramics, glass, lithics, stone, some pigments, geological specimens

Characteristics:
- Have undergone extreme pressure or heat
- Not combustible at normal temperature
- Ceramic and stone are porous and will absorb water, salts, pollution, acids
- Glass and metal can be chemically modified and are susceptible to corrosion.
- Except for certain types of glass, not sensitive to light
- Susceptible to mechanical damage (e.g., breakage and abrasion)

c. Composite Objects

Composite objects (mixed media objects) are common in park museum collections. These objects are made up of two or more materials. For example, a painting is comprised of a wood frame and stretcher, a canvas support, a variety of pigments of organic and inorganic origin, and a coating. A book may be comprised of several materials (e.g., paper, leather, glues). Composite objects are subject to all causes of deterioration. Besides individual effects, each material of the object reacts to environmental extremes and changes at different rates. These different materials can react in opposition to each other, setting up physical stresses and causing chemical interactions that may cause deterioration.

2. <u>Types of Deterioration/Damage</u>

Deterioration of all matter is inevitable. It is defined as any physical or chemical change in the condition of an object. It is the natural process by which an object reaches a state of physical and chemical equilibrium with its immediate environment. Damage is associated with deterioration that occurs as a result of an accident

or one time deleterious action (e.g., breakage, scratch, tear). The types of deterioration can be divided into three broad categories: physical, chemical, and biological. **Deterioration of material most often results from a combination of agents working simultaneously together.**

a. Physical Deterioration

1) Dimensional changes or changes in the structure of an object are usually caused by instability or improper levels of temperature and relative humidity. Examples of physical deterioration include:

- Melting of materials
- Burning or scorching
- Cracking or buckling of metals (e.g., expansion or contraction caused by fluctuating temperatures)
- Swelling or warping of organic materials caused by high relative humidity
- Shrinking, warping or checking of organic materials caused by low relative humidity

2) Structural or surface damage that is the result of a mechanical force. Examples of mechanical damage include:

- Shattering, cracking, or chipping caused by impact
- Crushing or distortion caused by a harder material pressing against flexible material
- Abrasion (e.g., rubbing of a harder material against a softer material)
- Structural failure (e.g., metal fatigue, tear in paper document, rip in a textile)

b. Chemical Deterioration

1) Changes in the material make-up of an object because of a reaction with another chemical substance. Chemical changes usually depend on the presence of a second substance, such as water. Examples of chemical damage include:

- Oxidation of metals (e.g., rusting)
- Corrosion of metals and stone caused by air pollution
- Damage to pigments by air pollution or reaction with other pigments
- Staining of paper documents by acidic matting materials

2) Changes in the color or structural strength of organic objects caused by exposure to excessive levels of light. Examples of light (photochemical) damage include:

- Fading of dyes and pigments
- Darkening of resins
- Darkening and embrittlement of pulp papers

- Embrittlement of textile fibers
- Bleaching of many organic materials

c. Biological Deterioration

Damage caused by the activities of animals and plants. Examples of biological damage include:

- Loss of organic materials because of feeding by insect larvae or adult insects, or by rodents
- Rotting of wood because of fungal growth
- Destruction of textile, leather and other organic materials by molds
- Staining of textiles and paper by mold

3. <u>Inherent Characteristics of Objects</u>

In addition to deterioration caused by the environmental agents of deterioration, certain types of objects will deteriorate because of their internal characteristics. This mechanism of deterioration is called inherent vice. Inherent vice refers to physical or chemical properties naturally found in the materials used in the manufacture of an object, either because of the compatibility of different materials, or because of the use of poor quality or unstable materials.

Materials found in nature often possess characteristics which protect them from natural degradation. Their structure and composition may include features such as protective layers, insect and mold resistant chemicals, and photochemical protection. Processing of these natural materials during object manufacture can cause the loss of these natural safeguards. Quite often, additives are employed at some point in an object's manufacture in order to obtain a result independent of any concern for long-term preservation (e.g., the addition of metallic oxides in the manufacture of weighted silk fibers). The result is the creation of inherently less stable materials, or combinations of mutually incompatible substances which have damaging interactions. Sometimes an object's deterioration results entirely from the physical contact of composite materials (e.g., a highly acidic paper label adhered to a leather trunk).

a. Impermanent Materials

The property of inherent vice frequently occurs in objects as a consequence of a manufacturing process that does not incorporate a high regard for the object's permanence (e.g., the introduction of cellulose nitrate film or wood pulp paper in the 19th century). Many objects in park museum collections were made to fulfill temporary needs, and thus, inherent vice is a common characteristic. Objects made from the synthetic materials of the 20th century often were not created with longevity as a goal.

b. Structural Nature

Inherent vice also can be related to the structural nature of an object. As a result of inappropriate design or construction methods, an object may be subject to eventual structural failure. The deficiency may be in the mechanical joining of components or simply the failure to consider all the features of the individual material elements (e.g., mounting a dimensionally changing material to a rigid support). Drying cracks that may be observed on a painting are due to internal stresses caused by the drying process rather than to external environmental agents. They are caused by the composition of the paint film and the techniques of application.

c. Historic Use

Finally, an object may be altered during its historic period of use in such a way that inherent vice becomes a legitimate concern. There are instances where an object is originally maintained or treated within its historical context in a way that complicates or accelerates its decay, (e.g., the application of dissimilar paint layers on an object). The functional use of a properly manufactured object may lead to its own eventual and inherent destruction (e.g., a wooden bowl which is saturated from extensive use as a container for oil).

Deterioration caused by inherent vice is often difficult to detect because little or no information may be available on the selection and processing of raw materials, manufacturing details, and previous use of an object. Through extensive review of collected objects and study of artifact technology, however, curatorial staff can begin to identify these problems and become more familiar with the problem of inherent vice in park museum collections.

C. TEMPERATURE AND RELATIVE HUMIDITY

1. Temperature

Temperature is the measure of motion of molecules in a material. When an object is subjected to an increase in temperature, the molecules that make up its constituent material speed up and spread out. The material then expands. When an object is subjected to a decrease in temperature, the molecules slow down and come closer together. Its material then contracts.

Of all the environmental agents, the park staff and visitors are most aware of temperature because of the comfort factor. The important points to keep in mind about temperature are as follows:

a. Generally, the lower the temperature the better, because the rate of chemical reactions and biological activity decreases as the temperature decreases. High temperature accelerates chemical reactions. For example, high temperature leads to the deterioration of cellulose nitrate film. If not detected and controlled, this deterioration can lead to a fire. Most chemical reactions, including those that cause museum objects to deteriorate, double in rate with each increase of 10°C (50°F). High temperature also tends to promote biological activity, such as mold growth.

b. In addition to accelerating chemical reactions, high temperature can cause damage by melting waxes and causing other materials to lose their consistency. A rapid increase or decrease in temperature may cause the separation or splitting of objects made-up of different non-moisture absorbent materials having different expansion rates (e.g., different types of metals, glass and metal, metal and stone, and painted materials.)

c. In exhibit and storage spaces, where comfort of people is a factor, the recommended levels of temperature are 18-20°C (64-68°F). In those museum storage spaces where human comfort is not a factor, the temperature level for mixed collections may be maintained just above freezing, avoiding fluctuations that may cause condensation on cold surfaces.

d. The upper limit of temperature should not exceed 24°C (75°F).

e. Avoid abrupt changes in temperature. Fluctuating temperatures can be doubly destructive because matter tends to expand and contract as temperature increases and decreases. When an object is made of two or more materials that respond to temperature changes at different rates, destructive stresses can develop. Repeated freezing and thawing in objects having high water content also causes damage.

f. Temperature also is a primary factor in determining relative humidity levels. The temperature affects the ability of air to

hold water. The relationship between temperature and relative humidity is discussed in the following section.

2. Relative Humidity

Water vapor plays a role in various chemical, physical, and biological forms of deterioration. Sources for water vapor include: rain; lakes, rivers, and oceans; wet ground; broken gutters, leaking pipes; moisture in walls; human respiration and perspiration; wet mopping; flooding; and cycles of condensation and evaporation. Many objects (e.g., those made of wood) contain water as a constituent material, the quantity changing according to the availability of water vapor in the surrounding air. Most metal objects corrode in the presence of damp air, and organic materials are more likely to be attacked by various biological pests in damp conditions. They key factor in these situations is not simply the amount of moisture in the air, but rather the relationship between the air's water content and its temperature. This relationship is relative humidity (RH).

A relative humidity reading in a room or any volume of air relates how far the air is from being saturated with moisture. "50% RH", for example, means that the air being measured has 50% of the total amount of water vapor it could hold, assuming that there is no temperature change. It is important to realize that temperature determines how much moisture the air can hold. As temperature increases, the air's capacity to hold water vapor increases. This is because an increase in the temperature causes the molecules in air to spread out, creating more space for water molecules. For example, warm air at 25°C (77°F) can hold a maximum of about 24 grams/cubic meter (g/m^3), whereas cool air at 10°C (50°F) can hold only about 9 g/m^3 water vapor.

As stated above, the actual water vapor content of air is not significant by itself. The linkage with temperature is crucial. For example, wood loses moisture (and shrinks) as relative humidity decreases. This will occur when the temperature is rising and the moisture content of the air remains constant, or even if it increases, so long as the relative humidity itself continues to decrease.

In a closed volume of air, when moisture content is constant, a rise in temperature results in a decrease in relative humidity, and a drop in temperature results in an increase in relative humidity. For example, turning up the heat in a room will decrease the RH. Adding ice to a glass of water may decrease the temperature of the surrounding air to the dew point causing condensation to occur on the glass surface.

a. The Psychrometric Chart

The relationships between relative humidity, temperature, and several other factors, such as absolute humidity and dew point,

can be displayed graphically on a psychrometric chart. Refer to Figure 4.2 for an explanation of how to use this chart.

Absolute humidity (AH) is the quantity of moisture contained in a given volume of air at a certain temperature. One way to express the measurement of AH is in grams of water per cubic meter of air.

Dew point (or saturation temperature) is the temperature at which air would be saturated by the water it contains, i.e., when it would reach 100% RH by cooling. Further cooling would result in water being forced out of the air as condensation. The water vapor condenses on surfaces, (e.g., window panes and walls). In the air, water vapor may also condense on dust, smoke, salt and other particles. If the dew point is below freezing, water vapor changes directly to ice (e.g., frost).

Relative humidity, stated as a percentage (0%-100%), relates the moisture content of the air being measured to the amount of water vapor it could hold at saturation, assuming that there is no change in temperature. Another way of stating this concept is by the following formula:

$$RH = \frac{\text{Absolute Humidity of Sampled Air} \times 100}{\text{Absolute Humidity of Saturated Air at Same Temperature}}$$

The following example calculation illustrates why the relative humidity of heated air inside a building is usually quite low in the winter. During cold winters, the relative humidity of the air outdoors often is low. Bringing this air inside and heating it without changing the absolute humidity further decreases the RH level of the inside air. A cubic meter of air in a closed space at 20°C (68°F) can hold a maximum of 17.0 grams of water vapor. If there are only 8.5 grams of water in the air, the relative humidity is as follows:

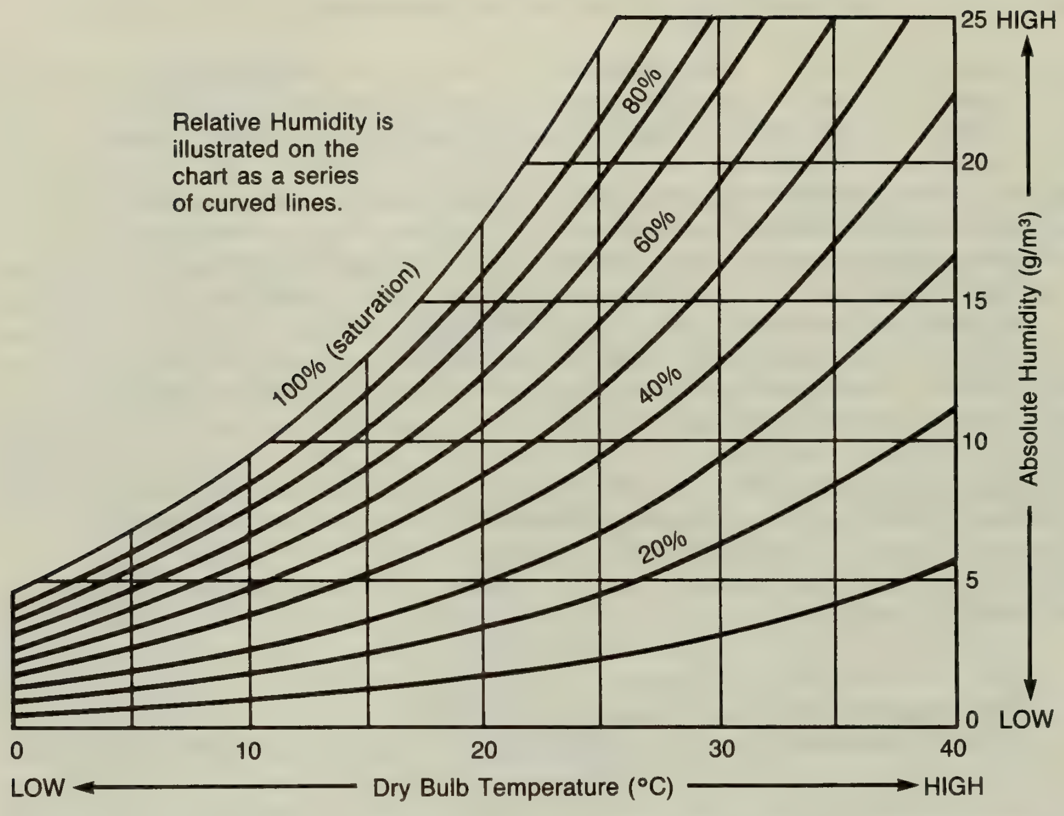
- The AH of the sampled air = 8.5 grams
- The AH of the saturated air at 20°C = 17.0 grams

$$RH = \frac{8.5 \times 100}{17.0} = 50\%$$

If the temperature is increased to 25°C (77°F), the same cubic meter of air can hold a maximum of 23.0 grams of water vapor. The change in relative humidity is as follows:

- The AH of the sampled air = 8.5 grams
- The AH of the saturated air at 25°C = 23.0 grams

$$RH = \frac{8.5 \times 100}{23.0} = 37\%$$



Follow any horizontal line (representing a specific amount of moisture in the air) from left to right on the chart (i.e., from lower to higher temperature levels). Note that RH decreases as temperature increases, so long as the quantity of moisture in the air does not change.

Again, follow any horizontal line, but this time from right to left (i.e., from higher to lower temperatures). Note that RH levels increase, although the amount of moisture in the air remains constant. Finally, 100% RH is reached at the left edge of the chart, when the temperature drops to the dew point. The air is now saturated and will have to give up water (e.g., as condensation) at any lower temperature.

Note that moving from left to right on the chart along the upward curving RH lines corresponds to increasing amounts of moisture in the air. This shows that maintaining a constant level of relative humidity, as the temperature rises, requires adding moisture to the air. Conversely, if the temperature falls, the downward sloping RH lines indicate that water has to be removed from the air to maintain RH at a constant level.

Turning down the heat to increase the RH may be beneficial to a museum collection if the RH is too low. On the other hand, turning down the heat in relatively damp conditions may increase the RH to the level where mold grows, or even to the dew point where condensation may harm vulnerable surfaces.

Figure 4.2. How to Use a Psychrometric Chart

b. Deterioration Caused by Relative Humidity

High relative humidity permits increased rates of chemical deterioration, such as the fading of dyes and the corrosion of metal. High RH levels cause swelling and warping of wood and ivory; softening and sticking of adhesives and sizing; cockling of paper; and slackening of stretched canvas paintings. Mold growth can occur when the RH level is above 65%. Insect activity also tends to increase at high RH levels. At the other extreme, very low RH levels cause shrinkage, warping, and cracking of wood and ivory; embrittlement of paper and adhesives, tendering of textiles; and the dessication of basketry.

Wood, paper, leather, basketry, textiles, ivory, and bone are examples of organic materials that are hygroscopic. Hygroscopicity is the ability of an object to absorb or release moisture to the air. These materials contain water as a constituent, and the amount is determined by the RH of surrounding air. These materials absorb water as RH increases and release it as RH decreases, eventually reaching a state of equilibrium with the surrounding environment, if conditions remain stable long enough. This concept is called the Equilibrium Moisture Content (EMC). Refer to Appendix N, Curatorial Care of Wooden Objects, pp. 6-8, of this handbook for a further explanation of this concept.

Rapid fluctuations of relative humidity may cause deterioration. **Diurnal (24 hour) fluctuations cause the most serious deterioration.** Changes in water content result in dimensional changes in hygroscopic materials. They swell or contract, constantly adjusting to the environment until the rate or magnitude of change is too great and deterioration occurs. This may be in imperceptible increments, becoming noticeable only over a long period of time. Or the breakdown of materials may be sudden. Typical damage includes cracking and delamination (e.g. cracking of wood, flaking of paint, disintegration of porous materials).

c. Standards for Relative Humidity Control

The goal is to monitor relative humidity and implement improvements to stabilize the environment and avoid extremes and wide fluctuations. Often very good control is feasible (e.g., by using well designed and constructed exhibit cases). Some degree of control is attainable in virtually any circumstances, and this is not dependent on having expensive mechanical systems.

Ideally, fluctuations should not exceed ±3% RH from a set point per month. Maximum and minimum levels should be established by assessing the nature and condition of the materials in the collection, as well as by considering the other factors discussed in Section D of this chapter. Ongoing monitoring of relative humidity and temperature is essential to a control program. Relative humidity levels should be maintained below 65% RH to

reduce the potential for mold. For metals, lower ranges of relative humidity (below 35%) reduce the chances of corrosion.

No single relative humidity setting will suit every museum object. Although research has been limited, enough information is available to specify optimum ranges of RH for most materials. Refer to Figure 4.3 for a listing of RH optimum ranges for many types of objects and materials. In applying the optimum standards to a park's collection, keep in mind the history of the objects (including the environmental conditions to which the objects have been acclimatized), the needs of the structure housing the objects, and the external climate of the area. Note: The appendices in this handbook that address curatorial care of different types of objects provide additional guidance on acceptable levels of relative humidity and temperature for specific types of materials.

Archeological Materials	
• Negligible Climate-Sensitive Materials	30% - 65%
• Climate Sensitive Materials	30% - 55%
• Significantly Climate-Sensitive Materials	30% - 40%
Natural History Materials	
• Plant, insect, and bird specimens, mammal skins and taxidermy mounts, specimens in preservative fluids (Keep at higher level to lessen evaporation.), bone and teeth (Keep at above 45%.)	40% - 60%
• Paleontological Specimens (Keep pyritic fossils at low RH level.)	45% - 55%
Paintings	40% - 65%
Paper	45% - 55%
Wood, Leather, Textiles, Ivory, Bone	45% - 60%
Photographs/Films	30% - 40%
Metals	0% - 35%
Ceramics, Glass, and Stone	40% - 60%

Figure 4.3. Relative Humidity Optimum Ranges for Various Materials Housed in a Park's Museum Collection[1]

D. MONITORING AND CONTROLLING RELATIVE HUMIDITY AND TEMPERATURE

1. The Reason for Monitoring

Monitoring the environmental factors in a space housing museum objects is similar to glancing at the dials and gauges on an automobile dashboard, and with regard to museum collection maintenance, equally important. In an automobile, most people can sense whether they are moving fast or slow. However, when the speed limit is 55 miles per hour, most prudent drivers will look at the speedometer periodically to determine their exact speed to ensure that they are not exceeding the speed limit.

Similarly, one can sense whether a basement is damp or a house is too dry in the wintertime, but in order to verify our senses it is necessary to look at a hygrometer. And like the speed limit, objects have environmental safety zones, which when exceeded, place museum objects at risk.

The objective of an environmental monitoring program is to determine the status of the collection, and to make a record of that status for future reference. The data provide an information base which documents existing conditions, identify problems that require special actions, and indicate the effectiveness of previous corrective measures. An ongoing program to monitor the environment is essential for the following reasons:

a. To determine whether the collection is threatened.

b. To ensure that control equipment is functioning properly.

c. To discover environmental trends: daily, weekly, monthly, and seasonally.

d. To determine the character of environmental zones within a structure.

e. To evaluate the effectiveness of any corrective measures that may already have been taken.

f. To record the effect of extraordinary events (e.g., broken windows, leaky roofs or pipes, long periods of rain or drought).

2. Establishing Environmental Parameters

The success of any monitoring program is dependent on planning. Each structure and every collection represent a special set of problems. The needs of the structure and the needs of the collection should be carefully weighed. Any corrective measure that is too narrowly focused, or unrealistic can have an adverse impact on one or both components. Such a mistake has occurred in furnished historic structures when sophisticated heating, ventilating, and air conditioning (HVAC) equipment has been installed in old structures in

order to maintain ideal environmental parameters of 45% to 55% RH at 18.3°C (65°F). In most instances the structures were damaged in some way, the systems were too complicated to operate as designed, and in most cases these systems were eventually abandoned or modified.

The types of questions to ask when establishing environmental parameters for a collection are:

- What is the appropriate environmental range for each collection?
- What is the character and significance of the structure in which the collection is housed?
- What is the environmental norm for the region of the country where the park is located?
- What is the realistic target range that can be achieved for the structure and the museum collection?
- What can and cannot be achieved?

It is important to remember that environmental conditions vary from floor to floor in a structure, and even within a room. For example, localized heating is possible when direct sunlight shines into a room, and condensation may occur near cooler exterior walls in the wintertime. In some regions it will not be feasible to maintain a constant environmental range throughout the year. Allowances will have to be made for seasonal variation. There are usually several appropriate actions which might be taken to correct a given environmental problem, including the eventual removal of sensitive objects.

Establishing Acceptable Ranges and Limits

Follow these steps to establish acceptable ranges and limits of relative humidity for exhibit or storage spaces:

a. Identify the nature of the museum collections housed in the space. Note the material makeup of objects (e.g., organic materials such as paper, wood, textiles, natural history specimens or inorganic materials such as metals, ceramics, glass). Describe the types of materials and approximate percentages of each material type. Identify climate sensitive objects, and; if appropriate, levels of importance for objects.

b. Refer to Figure 4.3 to determine acceptable relative humidity levels for various materials and types of objects. Most NPS collections are mixed, perhaps necessitating minor compromises in providing a suitable environment. Some objects, however, may need quite different environmental conditions to ensure long-term stability. For example, pyritic mineral and fossil specimens

require low humidity levels. One answer is to segregate these objects and locate or create an appropriate environment in a cabinet, room or space apart from the rest of the collection.

Aside from the "optimum" RH level or range, one must also consider an object's history and previous acclimation to another level. Objects in arid climates are best left in <u>stable</u> environmental conditions even if the RH is below the "optimum" range.

c. Determine the environmental conditions in exhibit and storage areas housing museum objects. <u>A full year's record of relative humidity and temperature is necessary</u>. Refer to Sections 3 and 5 of this chapter for guidance on establishing a program for monitoring relative humidity and temperature.

d. Consider the requirements and capabilities of the structure that houses the museum collection. For example, in colder climates excessive humidification can cause deterioration of outside walls by moisture buildup, unless the building is designed and constructed to prevent this problem. Gather and record the following information on each facility housing museum objects:

   1) Type of structure (e.g., construction, material makeup, and park function). Work with park maintenance staff to gather this information.

   2) Physical location of the structure (e.g., unusual environmental circumstances, such as high water table, snowbelt, floodplain; exposure and surrounding terrain; nearby bodies of water; presence of surrounding vegetation; rural or urban setting, proximity to an industrial area or a road).

   3) Condition of the structure (e.g., leaky roof, poor or no insulation, wet basement).

   4) If the collections are housed in a historic structure, consult with historical architects, engineers, and maintenance staff about legal or preservation restrictions regarding installation of systems in the building to control relative humidity.

   5) Study specific exhibit or storage spaces within each structure. Prepare a floor plan of each space. Answer the following questions:

      - Are there any external walls?
      - Are the walls and ceilings insulated?
      - What are the dimensions of the space?
      - How many doors and windows are in the space?
      - What are the existing means of controlling the relative humidity and temperature (e.g., heating, cooling, humidification, dehumidification)?
      - Are the objects exhibited in open areas or in cases?

- Are the objects stored in cabinets, drawers or on open shelving?

e. Consider the specific climatic zone and seasonal variations. Relative humidity levels that are desirable and maintainable in temperate areas of the United States may not be appropriate in arid areas.

As a general rule, stable RH levels are obtained with less expense and less complicated engineering by working with existing local conditions and attempting to buffer rapid fluctuations through various means, such as insulation, use of hygroscopic building materials, and judicious temperature control. In arid areas the resulting RH level, if maintained with minimal fluctuation, will be desirable for most objects already acclimated to a low level.

Seasonal adjustments in set points for RH are not harmful so long as the changes are not abrupt. A gradual shift from the low end of the desirable range in winter to the high end in summer probably will save money, as well as reduce the chance of damage to the building by condensation in winter.

Obtain local climatic information from Weather Bureau publications, local newspapers, and, if established, park weather stations. Obtain from the Weather Bureau a copy of the publication Local Climatological Data, Annual Summary with Comparative Data, 1985 that was prepared by the National Oceanic and Atmospheric Administration. This publication provides the average high and low daily temperatures, daily precipitation, percentage of sunshine, monthly averages for precipitation for the last 30 years, monthly and annual temperatures for the last 30 years, snowfall, wind, and relative humidity.

3. Monitoring Equipment

The National Park Service uses several types of monitoring instruments. The three instruments most commonly used for gathering and recording data on relative humidity and temperature levels in spaces housing museum collections are a psychrometer, a hygrothermograph, and a hygrometer. Refer to the NPS Tools of the Trade for descriptions of and sources for instruments used in monitoring relative humidity and temperature levels.

a. Psychrometer

A psychrometer is the most reliable instrument for determining the relative humidity and temperature. It is used to record daily readings (in the absence of a hygrothermograph), to make spot readings, and to calibrate dial hygrometers and hygrothermographs. The psychrometer works in the following way. Air is passed over a dry mercury thermometer and a second, identical thermometer that is covered by a wetted muslin wick. The wet bulb always reads lower than the dry bulb because of the cooling effect of the

evaporating water. The drier the air, the lower the reading. The two different temperature readings are recorded. The relative humidity is then calculated from a psychromatic table that is provided with the instrument.

There are two types of psychrometers: a sling psychrometer and an aspirating psychrometer. The sling psychrometer is whirled by the operator in order to pass air over the dry and wet bulbs. The required swing time is 1 minute. Read the wet bulb immediately, then the dry bulb. The procedure must be repeated until two or more wet bulb readings are the same. The aspirating psychrometer, powered by a battery, includes an electric fan that steadily blows air over the bulbs at the correct speed. Both these instruments are accurate to ±5% RH. The aspirating psychrometer is more reliable because it minimizes possible errors by the operator. It ensures a constant air flow past the wick.

Before using this instrument, read the manufacturer's instructions. To ensure the instrument's accuracy, keep the following points in mind:

1) Keep wick closely fitted to the thermometer bulb.
2) Do not touch the wick.
3) Keep the wick clean.
4) Use only deionized water to wet the wick.
5) Ensure that the aspirating psychrometer has a good battery.

b. Hygrothermograph

Hygrothermographs record relative humidity and temperature levels continuously over a period of 1, 7, 31, or 62 days. This instrument consists of six major components:

1) The housing

2) A temperature element, which may be a curved bourdon tube or a bimetal strip.

3) A relative humidity element, which may be a human hair bundle or a polymer membrane.

4) Linkage arms and recording pens.

5) A drive mechanism which may be spring wound or battery operated, that rotates a chart.

6) A chart, which may be wrapped around a cylindrical drum or in the form of a circular disk.

The thermometer (e.g., bimetallic strip) and the hygroscopic material (e.g., human hair) are connected to arms with pens at their tips. The upper pen records the temperature in degrees Fahrenheit (°F). The lower pen records the relative humidity.

The pens, filled with ink, rest on a revolving chart and move up and down in response to environmental changes.

Hygrothermographs are accurate within $\pm 3\%$ to 5% RH when properly calibrated. They are most accurate within the range of 30-60% RH. Note: All hygrothermographs require calibration at least quarterly (preferably once a month). Calibration is especially important after exposure to sudden extremes of humidity. Refer to Item 4 of this section for instructions on calibrating hygrothermographs.

Before using this instrument, read the manufacturer's instructions for operation and maintenance. Hygrothermographs are very delicate instruments and are easily damaged by improper handling. Keep the following points in mind:

1) Keep the instrument clean, and free of dust.

2) Locate the instrument in an area that minimizes vibration.

3) Do not touch the relative humidity sensor.

4) Replace the relative humidity sensor when the instrument requires frequent RH adjustments during calibration.

5) Keep the pens clean and free flowing.

6) Use only the purple glycerine based ink supplied with the instrument. Alcohol based inks for felt tipped pens will not work in metal pens. Note: Cartridge (felt-tip) pens are available for hygrothermographs. They are easier to use. Using cartridge pens eliminates ink blotted charts and stained hands. However, these pens have a shorter shelf life. If properly maintained, the metal pen points with ink are still more cost-effective.

Before placing chart on the instrument's drum, date the chart, and record on the reverse side of the chart the instrument's number and location. Note: Temperature readings are recorded as degrees Fahrenheit (°F) on the hygrothermograph chart. Permanent records of temperature levels should be recorded as degrees Celsius (°C). The formula for converting °F to °C is: °C = (°F-32) x .555. Conversely, the formula for converting °C to °F is: °F = (°C x 1.8) + 32.

c. Hygrometer

Hygrometers are used to measure relative humidity levels in spaces not monitored by a hygrothermograph and in museum storage and exhibit cases. When using a hygrometer, it is important to also use a thermometer to record the temperature. The two types of hygrometers are dial hygrometers and electronic hygrometers. An electric hygrometer may be used to calibrate other instruments in

place of a psychrometer. Paper strips impregnated with cobalt salts are called humidity indicator strips and may be used when a dial hygrometer would be too conspicuous. Note: hygrometers are generally not very accurate, and they often are difficult to calibrate. Refer to the NPS Tools of the Trade for descriptions and sources of these instruments.

4. Instructions for Calibrating a Hygrothermograph

In order for the hygrothermograph to be accurate, and records based on its readings to be of value in interpreting the data, this instrument must be calibrated at least quarterly and preferably monthly. The calibration process involves checking instrument readings against known relative humidity and/or temperature levels and making adjustments as necessary. Note: Temperature rarely goes out of calibration, because the bimetal element is very stable. Use either a sling psychrometer or an aspirating psychrometer to calibrate each hygrothermograph. Once the relative humidity and temperature levels are determined, adjust the hygrothermograph to match the known conditions. Use the "Hygrothermograph Calibration Record" illustrated in Figure 4.4. The instructions for using this record are as follows:

a. On the first line, record the brand and model of the hygrothermograph being calibrated. Record the serial number and the NPS property number on the second line. Recording this information facilitates comparing test records for a single instrument over a period of years.

b. On the third line, record information about the psychrometer being used to calibrate the hygrothermograph. In the block for "TYPE," enter either "sling" or "aspirating" as appropriate. Record the serial number and the NPS property number on the fourth line.

c. During the calibration, both the hygrothermograph and the psychrometer must be in the same immediate vicinity. Record this location as specifically as possible on line five.

d. On the sixth line, record the name and title of the person who is conducting the calibration tests. Insofar as possible, the same person should conduct all tests on a single hygrothermograph.

e. Conducting the calibration:

1) Read and follow any suggestions made by the manufacturer concerning calibration of the instrument.

2) At a selected time, record the information requested on the chart: date, time of day, relative humidity reading from the hygrothermograph, and temperature reading from the hygrothermograph.

3) Immediately after recording readings obtained from the hygrothermograph, operate the psychrometer at the same location

and in accordance with the manufacturer's instructions. Record the relative humidity and dry bulb temperature readings indicated by the psychrometer in the spaces provided on the record.

4) Adjust the hygrothermograph to match psychrometer readings. Follow the instructions for making adjustments provided by the instrument's manufacturer. If the average differences are found to be greater than 1% relative humidity or 1° temperature, adjust the hygrothermograph up or down by amounts equal to the average differences. For example, if the hygrothermograph is recording high by a factor of 5.6%, adjust the recording arm so that it reads about 5 to 6% lower. Likewise, if the hygrothermograph is recording temperature low by a factor of 4°, adjust the recording arm so that it reads about 4° higher.

5) If there are differences between the two relative humidity readings and/or the two temperature readings, record them in the appropriate spaces. For example, if the relative humidity reading on the hygrothermograph was 48% and the reading from the psychrometer was 45%, record the difference between them as "hygro. high by 3%." <u>Always record differences in terms of whether the hygrothermograph reading is higher or lower than the psychrometer reading</u> because it is the hygrothermograph that is being calibrated. If there is no difference between two readings, simply enter "0 difference" in the space.

6) Wait for 15 minutes, then repeat steps 3 and 4. Repeating Step 3 is necessary, because the instrument's linkages often require time to equalize. If applicable, adjust instrument again.

7) If significant differences still exist (over 5%) after a third check, refer to the instruction manual for the hygrothermograph to determine why the instrument might be malfunctioning. Relative humidity readings most often are erroneous because of a broken or dirty hair element. Temperature readings can be in error because of dust or other fouling of the bimetallic strip. <u>Read and follow the manufacturer's instructions for cleaning, maintaining, and repairing the hygrothermograph</u>.

8) After the calibration has been completed and the hygrothermograph has been adjusted properly, file the calibration record form with the charts from the hygrothermograph. It is important that the forms be kept so that they can be compared in the future to other calibration records on the same instrument in order to determine if there is a pattern of incorrect readings. If it is determined every time that it is calibrated that a hygrothermograph consistently has been giving incorrect readings, consider returning it to its manufacturer for repairs.

NATIONAL PARK SERVICE
HYGROTHERMOGRAPH CALIBRATION RECORD

Hygrothermograph: Brand________________________ Model______________
Serial No.________________ Property No.____________
Psychrometer: Brand________________ Type_________ Model__________
Serial No.________________ Property No.______________
Location of Hygrothermograph:____
Name and Title of Person: ____

		RELATIVE HUMIDITY READINGS			TEMPERATURE READINGS		
DATE	TIME	HYGRO.	PSYCH.	±% DIFF.	HYGRO.	PSYCH.	±% DIFF.

Figure 4.4. Hygrothermograph Calibration Record

5. Reading Hygrothermograph Charts

Anyone who has inspected a hygrothermograph chart may have observed recorded readings that defy simple explanations. There are many variables that may account for unusual readings. Some of them are as follows: the quality and the condition of the structure in which the collection is housed (sometimes referred to as the envelope); staff activity; public visitation; HVAC equipment performance and failure; barometric pressure; weather; the condition of the monitoring equipment and its accuracy; and unusual sources of moisture such as curing concrete, underground cisterns, and clogged gutters. Therefore, it is impossible to explain all of the patterns which will be encountered in a monitoring program. However, it is possible to illustrate some of the more common patterns and to suggest possible causes. This section provides several examples of hygrothermograph charts and possible explanations for the readings.

a. Examine the hygrothermograph chart that is illustrated in Figure 4.5. This recorded pattern clearly illustrates the relationship that exists between temperature and relative humidity. As the temperature decreases, relative humidity increases. And as the temperature increases, relative humidity decreases. This pattern appears most often in well enclosed spaces with minimal human activity (e.g., storage space). A large number of people congregating in a room might cause an increase in both relative humidity and temperature.

b. Examine the hygrothermograph chart that is illustrated in Figure 4.6. This recorded pattern is characteristic of air handling equipment that is regulated in some manner. In this instance, a thermostat is regulating a furnace. The saw tooth pattern is often mirrored in the relative humidity reading. A similar pattern could be generated by humidification equipment or dehumidification equipment which is controlled by a humidistat. Cycling is generally considered to be very harmful to museum materials that respond quickly to environmental change. It is also very difficult to completely eliminate cycling from most ordinary HVAC equipment.

c. Examine the hygrothermograph chart illustrated in Figure 4.7. Weekend activity or nonactivity may result in a different pattern than weekday activity. In this instance, the furnace was turned down or off. Note the resulting rise in RH over the course of the weekend. Note too, the high temperatures and the resulting low relative humidity during the week. In this instance, lowering the thermostat setting and keeping the same setting throughout the week would be much better for the museum objects and would conserve energy.

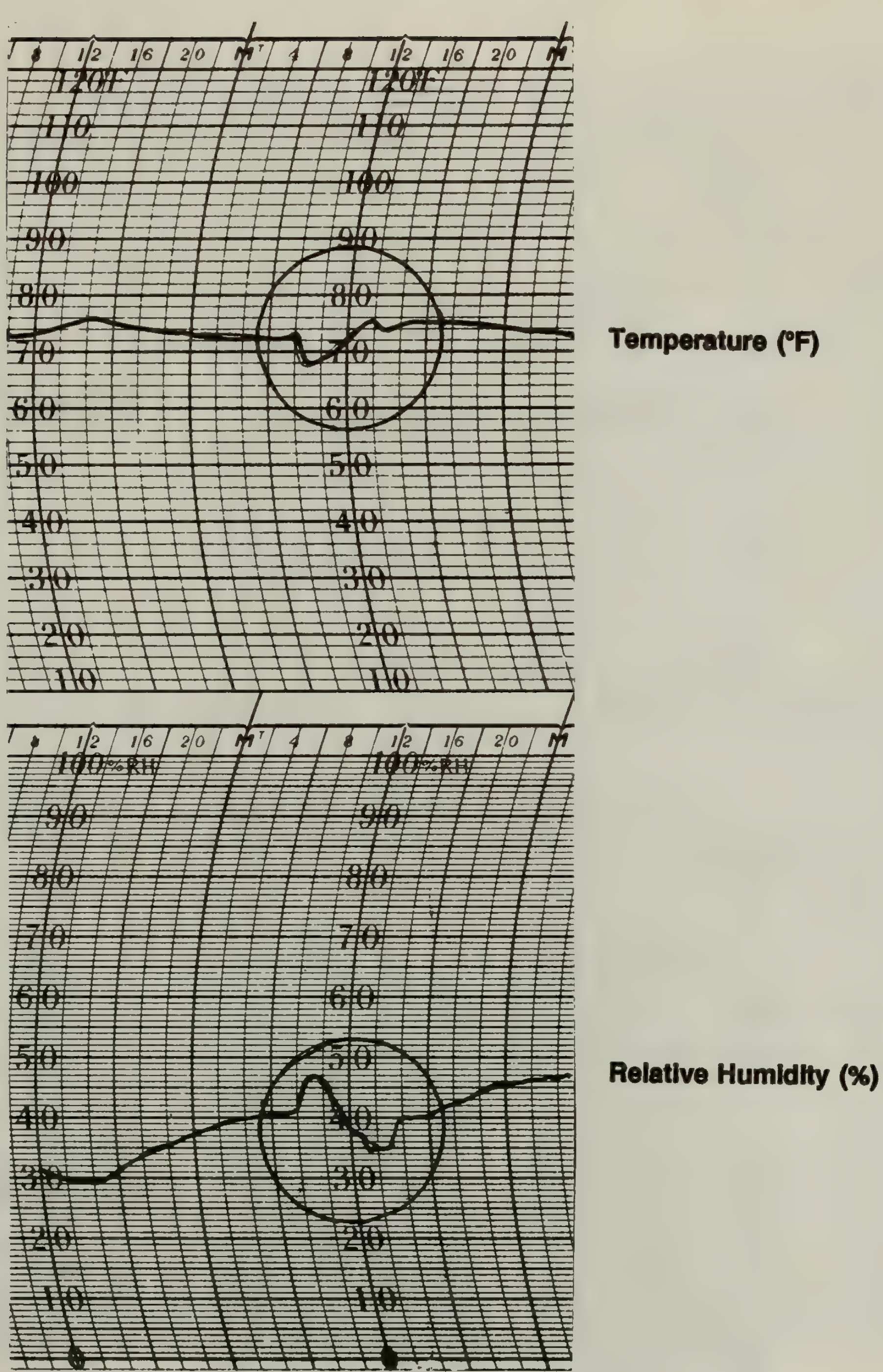


Figure 4.5. Hygrothermograph Chart that Illustrates the Relationship Between Temperature and Relative Humidity

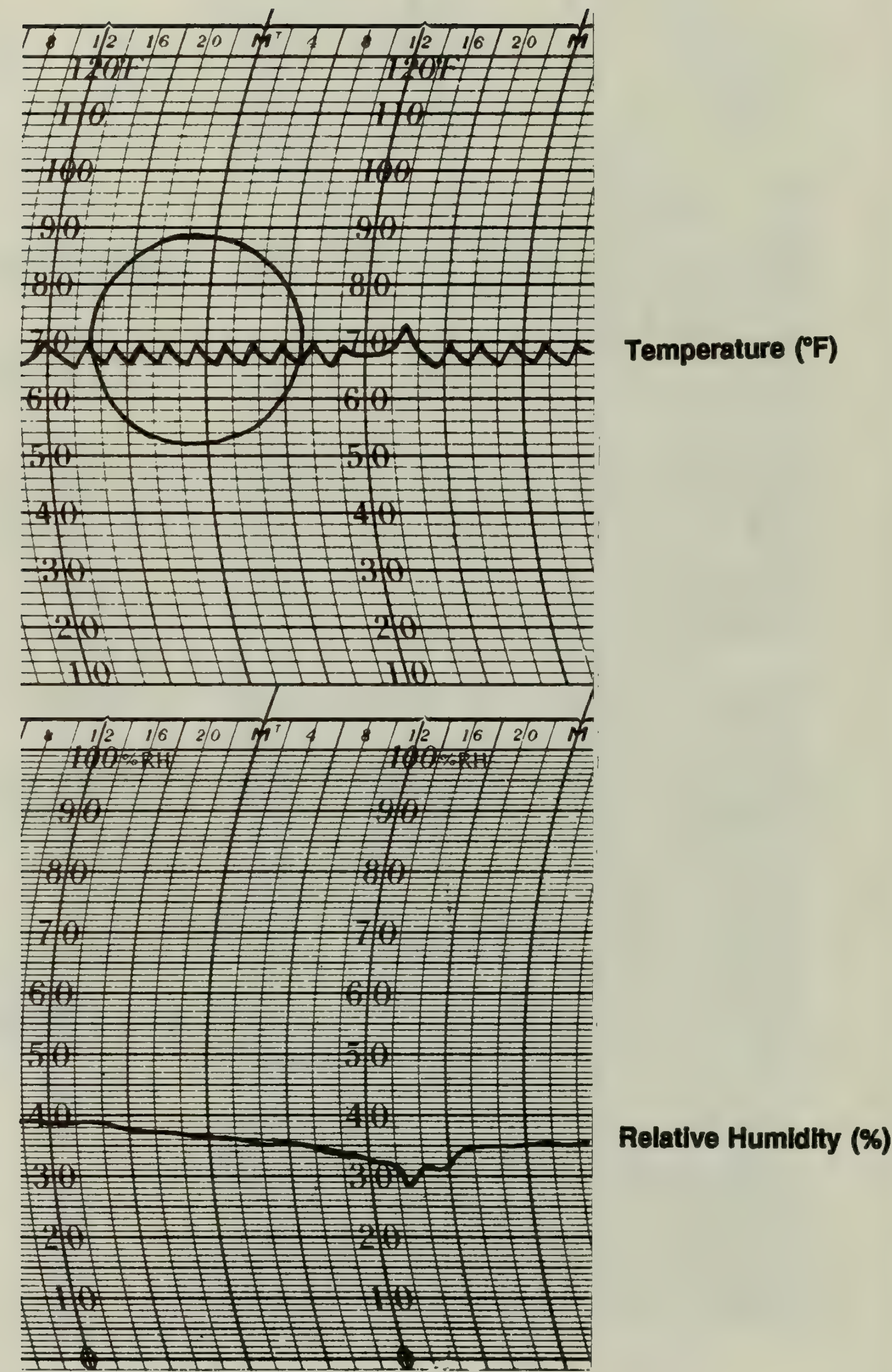


Figure 4.6. Hygrothermograph Chart that Indicates Operation of Air Handling Equipment

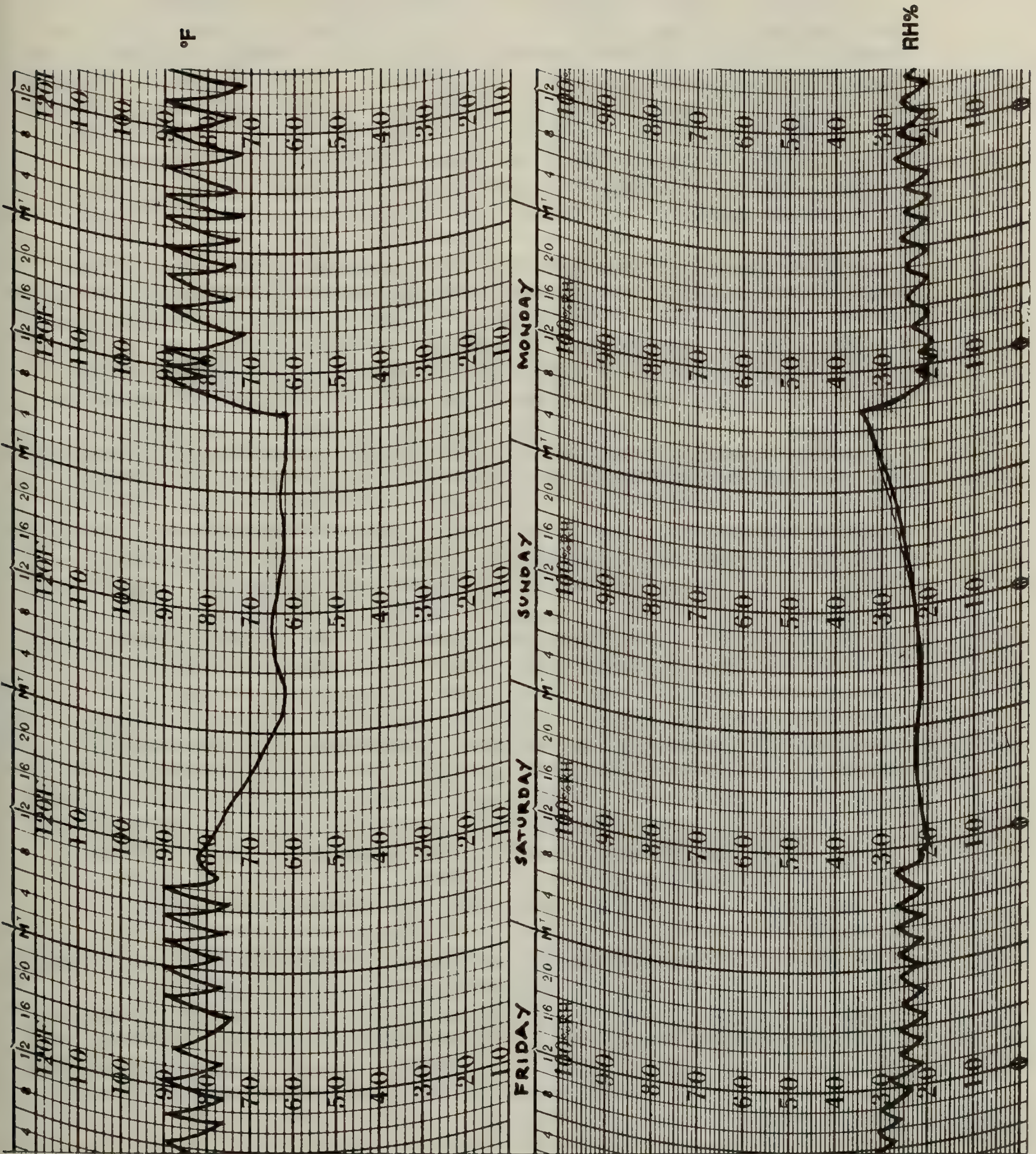


Figure 4.7. Hygrothermograph Chart that Illustrates the Results of Turning Off the Furnace

d. One hygrothermograph <u>may not</u> be sufficient for an ongoing monitoring program, especially in a furnished historic structure that is located in the temperate zone (e.g., summers are hot and humid and winters are cold and very dry). For example, it may be necessary to place a hygrothermograph in different spaces (e.g., basement, first floor, and second floor) of a historic structure housing museum collections to gather enough data to evaluate conditions prior to taking any actions to modify heating during the winter months.

For this example situation, the hygrothermograph charts reveal that the conditions within the structure are too damp for the most environmentally sensitive objects (e.g., furniture and wooden objects, textile and paper objects): the basement has consistently high RH levels, the first floor is somewhat drier, and the second floor is drier than the first floor. In addition, readings taken from a hygrothermograph located in an outdoor station, indicate that the conditions within the structure are wetter than conditions outside.

Upon examining this data, the curatorial staff needs to look (with a critical eye) for evidences of mold/insect activity and or damage, and for sources of moisture in the structure's walls and basement. For example, rainwater runoff from the roof may be entering the basement through deep window wells and masonry cellar walls. In this instance, the retention of moisture in the structural fabric is identified to be the cause of the high relative humidity levels indicated by the charts. Once the problem is identified, corrective steps can be taken. While waiting for modifications to correct the runoff problem, a temporary measure may be to locate a dehumidifier in the basement. The use of fans may be necessary to ensure proper circulation of air. It is important to include all appropriate disciplines in the decision-making process, including the Regional Curator, a conservator, a historic architect, and maintenance staff.

The data base represented by the hygrothermograph charts <u>provides an opportunity to approach a problem of this nature in an objective rather than a subjective manner</u>. The charts clearly indicate the existence of a problem which threatens both the collection and the structure. Continued monitoring will indicate whether or not the corrective actions that were taken have been effective.

6. <u>Organizing and Summarizing Data from Hygrothermograph Charts</u>

Organizing the Data

It is essential to organize the data recorded by each hygrothermograph. The hygrothermograph charts are important documents. At the end of each recording period (e.g., 7 days, 31 days), take time to examine all charts and to organize data. Use the "Museum Environmental Monitoring Record" in Figure 4.8 to organize the data.

Instructions for the use of this form are as follows.

a. Column 1. Record the current date as DAY/MON/YEAR, for example "01/06/88" for June 1, 1988.

b. Column 2. Record the time of day, using the 24-hour clock. Thus, 8:15 a.m. would be "0815" and 3:45 p.m. would be "1545".

c. Columns 3a and 3b. Records of exterior conditions should be made at least once a day. Data should be taken from the park's weather station if there is one; otherwise that information can be obtained from the National Weather Service (NWS), from the local newspaper, or from a local radio or television station, depending upon which one provides the most accurate data. Be aware that weather conditions around the museum can be somewhat different than conditions around the local weather station.

d. Columns 4a and 4b. Record how the museum's thermostat and humidistat are set. If the building is served by more than one climate control or HVAC system, there may be more than one set of control instruments. In that case, it will be necessary to complete one Monitoring Record form for each climate control system. Remember, the purpose of completing the form is to determine how interior conditions vary, if any, from how the climate controls are set and to determine the extent to which those conditions are influenced by exterior weather conditions.

e. Columns 5a and 5b. Records of interior conditions should be taken from an accurate psychrometer or recording hygrothermograph. They can be read daily from a hygrothermograph chart, but it generally will be easier to record the information the following week after the chart has been removed. If more than one monitoring instrument is being used, the park has two choices:

   1) Keep a separate Monitoring Record form for each instrument. This alternative should be chosen if the instruments typically reflect different conditions in different parts of the museum. Of course, this alternative also will be chosen if the museum has more than one climate control system because the space controlled by each system will be separately monitored.

   2) Average the readings from the different instruments and record the average on the monitoring record. This alternative may be chosen if the range between the high and the low readings on the different instruments does not exceed 5% relative humidity or 5°F temperature.

f. Column 6. Unusual weather conditions should be recorded whenever they are influencing interior conditions. For example, if it has been raining all day, that fact should be recorded because it might help explain a rise in relative humidity. In addition be

NATIONAL PARK SERVICE
MUSEUM ENVIRONMENTAL MONITORING RECORD

Col. 1	Col.2	Col. 3		Col. 4		Col. 5		Col. 6
		EXTERNAL		CONTROLS		INTERNAL		REMARKS
DATE	TIME	TEMP	RH	TEMP	RH	TEMP	RH	

Figure 4.8. Museum Environmental Monitoring Record

sure to note such events as: loss of electricity or fuel; breakdowns of mechanical equipment; occasions when outside doors have been kept open for extended periods, such as during maintenance activities; discharges of water sprinkler systems; water leaks or flooding inside the building; and any other events that might cause changes in normal interior climatic conditions. Also note whenever visitation has been exceptionally heavy or exceptionally light. The presence or absence of visitors (and staff) often can markedly effect interior climatic conditions.

Summarizing the Data

From data gathered from instruments and recorded on the monitoring record, it is possible to prepare summary reports for the temperature and relative humidity records. This type of information will be useful in discussing environmental control measures.

One suggested method of organizing relative humidity and temperature data from the charts of each hygrothermograph is to record in a table format the following information over a period of time (e.g., 4 to 6 weeks) maximum high temperature, maximum low temperature, maximum diurnal (24 hour) temperature change, maximum high relative humidity, maximum low relative humidity, and maximum 24 hour relative humidity change. For example, a park operates a hygrothermograph in each of two museum collection storage spaces. A suggested format for recording the above data taken from the weekly charts is as follows:

Chart Date	Data	Storage #1	Storage #2
5/18/87 -6/15/87	MAX. HIGH TEMP.	28.8°C (84°F)	28.3°C (83°F)
	MAX. LOW TEMP.	20.5°C (69°F)	18.8°C (66°F)
	MAX. 24 HR. TEMP. CHANGE	4°F	4°F
	MAX. HIGH RH	54%	56%
	MAX. LOW RH	45%	46%
	MAX. 24 HR. RH CHANGE	4%	3%

A second suggested method for summarizing the collected data is to prepare a graph. Graphs can be used to record both temperature and humidity. For temperature graphs, use the vertical axis for degrees fahrenheit and the horizontal axis for weeks of the year. For humidity graphs use the vertical axis for percent relative humidity and the horizontal axis for weeks of the year. The graph provides a picture of the changes over time in a room that is being monitored. Graphs from previous years can be quickly compared to a current graph to determine if conditions are the same or have changed. In a historic house the temperature readings from the different floors can

be plotted on the same graph to illustrate how temperature fluctuates throughout the house. Relative humidity readings can be graphed in the same way. When parameters for temperature and relative humidity have been established for a location, they can be drawn on a graph to show how often the readings are above or below the parameters. Graphs of the data can be a very useful tool for processing the information obtained from the hygrothermograph charts.

A third format for summarizing data is to prepare room-by-room records for a year. For each room (space), list each week (e.g., week 1, 2, 3) and give the following summarized data:

- High/low readings for temperature and relative humidity
- Fluctuation patterns of temperature and relative humidity by correlating with the time of day.
- Note maximum diurnal RH fluctuations.

An example of summarizing data in this format is as follows:

Furnished Historic Structure

Room A

Week 3: Temperature: 17.7°-21.6°C (64°-71°F)

Gradual rise in relative humidity through week; no rapid fluctuations.

Gradual daily fluctuations from 17.7°C (64°F) to 21.6°C (71°F) and back to 17.7°C; low ca. midnight, high ca. 10 a.m.

Relative Humidity: 22%-32% RH

Maximum Diurnal (24 hour) Fluctuation: 10% RH

Summarize the room (space) data by season (e.g., Winter, Spring, Summer, Fall) in the same format as above.

7. Controlling Relative Humidity

a. General Considerations

The goal of controlling the climate surrounding museum objects is to provide a stable environment that eliminates rapid fluctuations and extremes in relative humidity and temperature. In developing a strategy to control relative humidity and temperature, keep the following general points in mind:

- Because units of the National Park System are in many different climatic zones, acceptable ranges and limits of relative humidity must be established individually for each park and center based on: the local climate (e.g., tropical, temperate, arid), the nature and condition of the materials constituting the collection, the nature and condition of the structure housing the collection, as well as any other relevant factors. There is no general solution to a control problem. A program to control relative humidity is site-specific. Every structure and physical space that houses a museum collection presents a different set of variables that requires a specific approach to solve the problem.

- An effective control program requires information about the structure and the collection, and data about the surrounding environment. A park or center must record data for one year before establishing acceptable ranges and limits.

- Developing an approach to controlling relative humidity requires a team approach. Using the information and data gathered from the ongoing monitoring program, discuss control strategies with the Regional Curator, and, as appropriate, a conservator, historic architect, and a mechanical engineer. Strategies for controlling levels of relative humidity and temperature should keep energy costs in mind. Include the Regional Energy Coordinator in the decision-making process. Refer to NPS Special Directive 81-2, Energy Surveys and Retrofitting for Energy Conservation in Historic Structures and Structures Housing Collections and NPS-28, Cultural Resources Management Guideline for guidance.

- Controlling the climate includes both active and passive methods. Where possible, solutions to controlling relative humidity and temperature should explore simple modifications to a structure or space and employ the use of localized or portable mechanical equipment (e.g., humidifier, dehumidifier, heater, and air conditioner).

- Once control strategies have been implemented, continue the ongoing monitoring program to evaluate the effectiveness of the corrective measures.

b. Building Envelope

Obtain assistance in examining the structure and/or museum space within the structure for possible sources of moisture that may be causing high levels of relative humidity (e.g., leaking roofs, ceilings, and windows; leaking plumbing in an adjacent space; damaged gutters and downspouts; drainage problems; wet walls and foundations). Eliminating sources of moisture by repairing the structure or correcting drainage problems is essential to controlling interior conditions.

c. Passive Methods

1) In spaces housing museum collections, avoid turning heating/cooling equipment on during the day and off at night. This practice causes rapid fluctuations in RH levels.

2) The presence of large groups of people in a room raises the temperature which results in lowering the relative humidity. Control the size of visitors in furnished historic structures and exhibit spaces to prevent overcrowding. It may be necessary to lower the set point of the heating equipment to counteract a reduction in the relative humidity or to open and close doors within the building to change the circulation of air.

3) In exhibit and storage spaces locate sensitive objects away from spotlights, windows, exterior walls, air vents, and entrance doorways. Increased temperatures caused by the sun can be controlled by using existing blinds, curtains, drapes, or exterior shutters.

4) In temperate zones, reduce temperature levels during the winter. Lowering the set point of the heating equipment by several degrees raises the interior relative humidity to stabilize the conditions. It is <u>important to gradually reduce</u> the interior temperature level over a period of weeks. In the spring, <u>gradually</u> raise the temperature back to the appropriate set point.

5) Controlling relative humidity levels for sensitive objects (e.g., metals, textiles, paper, pyritic mineral and fossil specimens) may require the creation of a micro-climate to stabilize and maintain conditions. The use of a properly sealed museum storage cabinet or exhibit case with a buffering material (e.g., silica gel) can provide a proper micro-climate for sensitive objects.

   Silica gel, a high capacity moisture absorbent, is a porous granular, chemically inert material that can absorb 30-40% of its dry weight in water. Properly conditioned, this material stabilizes fluctuations in relative humidity by maintaining the appropriate level of (increasing or decreasing) moisture in the air surrounding museum objects. Refer to Appendix I, Section E of this handbook for guidance on using silica gel.

6) While ideal, it is not practical to store all museum objects in a space with a strict climate-controlled system. A more practical method for controlling relative humidity and temperature for large collections of sensitive objects (e.g., biological specimens in solution, climate sensitive archeological objects, photographic film) is to create a separate space within or adjacent to the existing storage facility to meet the special needs of these materials.

Appendix I, Section E of this handbook discusses this approach for storing archeological collections.

Assembling a super-insulated prefabricated building equipped with an environmental control system designed to maintain the appropriate RH and temperature levels is one approach to creating a separate space. Refer to the NPS Tools of the Trade for information about this structure.

d. Active Methods

A properly designed heating, ventilating and air conditioning (HVAC) system to establish and maintain appropriate levels of relative humidity and temperature and to filter particulates and gases from the air in a structure or space housing museum objects may be an ideal approach. The booklet The ABC's of Air Conditioning[4] (listed in Section H of this chapter) provides information on air conditioning systems. Installing an HVAC system that achieves the above requirements is not easy, and, often, is not a practical or feasible corrective measure. The decision-making process for considering such a system must address the needs and requirements of the structure and of the collection. Refer to Chapter 3, Section E of this handbook for a discussion of the needs of the structure.

The information and data provided by an ongoing monitoring program are an essential first step in the planning process for a system. The design process, especially with an historic structure, must consider architectural concerns (e.g., integrity of the fabric and the impact of vapor barriers, glazing, and ducts and vents on the fabric), operation (e.g., performance, energy costs) and maintenance.

In many instances, it may be more practical and less costly to use localized or portable humidifiers, dehumidifiers, heaters and air-conditioners. Use humidifiers and dehumidifiers that are controlled by humidistats to keep relative humidity levels within acceptable limits. (A humidistat, functioning like a thermostat on a heater, automatically switches on the equipment when necessary.) This equipment may not provide the level of control that a properly designed and maintained HVAC system can provide; however, properly located and maintained, humidifiers and dehumidifiers can help to prevent dangerous conditions. Refer to the NPS Tools of the Trade for sources of this equipment.

1) Humidifiers

Humidifiers are designed to quickly add moisture to the air in a controlled manner. During the winter use this equipment in spaces housing collections to counteract the drying effect of a heating system. Only use an unheated evaporative humidifier, because this type of humidifier does not disperse minerals in the water into the air and, if the humidistat malfunctions,

this type of humidifier will not raise the RH level above 65-70%. When using a humidifier, it is important to ensure that the humidified air is well-circulated. It may be necessary to place fans in specific locations to eliminate any pockets of stagnant or overly damp air in the space. The size and number of needed humidifiers depends on the size of the space, the air exchange rate, the differences between conditions inside and outside the building, and the number of persons passing through or working in the room. Before using this equipment, read the manufacturer's instructions for <u>operation</u> and maintenance. The <u>Humidification Handbook</u>[5] (source listed in Section H of this chapter) provides useful information about humidification.

2) Dehumidifiers

Use a dehumidifier for short periods of time to lower high levels of relative humidity. This equipment should not be used as a permanent corrective measure to control high RH levels.

The two types of dehumidifiers are: desiccant and refrigerant. The desiccant type forces air through a dry material (e.g., lithium chloride) to reduce moisture. The desiccant material is regenerated by blowing heated air through it to remove absorbed moisture. Use a desiccant dehumidifier in cold climates. The refrigerant type works on the same principle as a refrigerator. Use this type of a dehumidifier in warm climates. Before using this equipment, read the manufacturer's instructions for <u>operation</u> and <u>maintenance</u>. The <u>Cargocaire Dehumidification Handbook</u>[6] (source listed in Section H of this chapter) explains dehumidification. <u>Remember</u> dehumidifiers must be periodically drained.

E. LIGHT

1. The Nature of Light

Light can be defined as the visible portion of the electromagnetic radiation. This electromagnetic radiation is a source of energy that activates molecules, creating an environment for chemical change. Light comes from the sun and artificial sources and its presence can cause irreversible damage to museum objects. The unit of measurement for wavelengths of the electromagnetic spectrum is called a nanometer (1 nanometer equals 1 thousandth millionth of a meter). The electromagnetic spectrum can be divided into three segments: The short (ultraviolet) wavelengths range from 300-400 nanometers, the visible wavelengths range from 400-700 nanometers, and the long (infrared) wavelengths range from 760 nanometers and beyond. The short wavelengths, when absorbed, are more damaging than the longer wavelengths because they contain more energy.

Ultraviolet (UV) radiation is the most damaging segment of the light spectrum. This portion of the light spectrum cannot be seen with the naked eye. All forms of lighting (e.g., daylight, fluorescent lamps, tungsten (incandescent) and tungsten-halogen lamps) used in museums emit varying degrees of UV radiation. Daylight is the strongest source of ultraviolet radiation in most museums, although most fluorescent lamps emit higher than acceptable levels. Since it is not needed for visibility and is very damaging, ultraviolet radiation should be eliminated in museum spaces.

Light is that part of the electromagnetic spectrum that is visible to the human eye, from violet through blue, green, yellow, orange to red. The strength of the lighting is referred to as the illumination level or "illuminance" and is measured in units called lux (1 lumen per square meter) or footcandles (1 lumen per square foot). One footcandle equals about 10 lux.

It is important to keep the "reciprocity law" in mind. This principle states that low light levels for extended periods cause as much damage as high levels of light for brief periods. The rate of damage caused by light is directly proportional to the illumination level multiplied by the time of exposure. To reduce damage to objects from visible light, it is possible to reduce the amount of light and/or the time of exposure. A 200 watt light bulb causes twice as much damage as a 100 watt bulb in the same amount of time. A 200 watt bulb does twice as much damage in 10 hours of exposure as it does in 5 hours of exposure. Small amounts of light, well within the acceptable range, still cause damage. <u>Damage as a result of exposure to light is cumulative</u>. This damage cannot be reversed, however, it can be arrested by placing an object in dark storage.

Infrared radiation (IR), also invisible to the eye, causes heat buildup in objects. The distance of the light source from a museum object is a factor that should be considered. Lighting that is too close to an object will create a rise in temperature of the object,

resulting in damage to materials. This increase in temperature also will lower the water content of that object. Overheating also can be caused by incorrect use of spotlights throwing a concentrated beam of light on an object or part of an object. Incandescant spotlights generate a large amount of heat (infrared radiation), particularly in unventilated exhibit cases. Fluorescent fixtures emit very little heat; however, their ballasts, used to stabilize the electric current in the circuitry can create heat build-up. Another source of heat build-up from light is direct sunlight (high in infrared energy) emerging through a door or window.

It is important that the museum staff be able to identify the types of materials that are adversely affected by light and recognize signs of damage. The most obvious sign of light damage is the fading or bleaching of materials such as textiles, paper (especially inks and watercolors), photographs, book covers, wood furniture, leather materials. Light has the potential to be the most damaging agent to sensitive organic materials, e.g., natural history specimens (furs, feathers, etc.) and other organic material whose surface color is important. Another sign of light damage that may not be as easily detected is the embrittlement of materials such as textiles, paper, and leather. Embrittlement is the actual progressive breakdown of molecular bonds, causing materials to lose resiliance and strength.

2. Light Level Standards

The human eye can easily adapt to a tremendous range of illumination. Strong artificial lighting has become so available and widely used in the 20th century that high levels of light are now expected and considered to be necessary by many exhibit designers. However, this high level of lighting is not necessary when exhibiting objects and, in fact, is damaging to the objects on display.

Light levels are relative and very difficult to measure with the naked eye. In a brightly lit room, a low lighted exhibit case may appear to be dark. In a room with lower overall light levels, the same exhibit case may seem to be brightly lighted. The eye requires time to adjust from a brightly lighted area to a dimly lighted area, particularly when coming from outside daylight into a darker exhibit area. A gradual decrease in lighting is suggested when going from a non-exhibit space into an exhibit. Objects that are sensitive to light should not be displayed in areas near a window or an outside door.

Museum lighting must be controlled to protect objects from excessive visible light and any ultaviolet radiation. Only the recommended light levels should be used when exposing museum objects to light for any extended period of time. Refer to Figure 4.9 for the maximum acceptable illuminance level for light sensitive materials.

50 lux (5 footcandles) for especially light sensitive materials (e.g., dyed and treated organic materials, textiles, watercolors, tapestries, prints and drawings, manuscripts, leather, wallpapers, natural history specimens, including botanical specimens, fur and feathers.

200 lux (20 footcandles) for undyed and untreated organic materials, oil and tempera paintings, and finished wooden surfaces.

Generally, other materials (e.g., metals, stone, ceramic and glass) are less light sensitive and may be exposed to higher levels up to a maximum of 300 lux. However, when these materials are exhibited with light sensitive materials, light levels must be controlled at the levels acceptable for the most sensitive materials.

Ultraviolet radiation: Controlling the level of ultraviolet radiation by installing filtering materials between the light source and the museum objects is mandatory if the ultraviolet radiation exceeds 75 microwatts/lumen.

Note: **These light levels represent compromises at best because any exposure to light will cause damage. There is no minimum level below which damage will not occur.**

Except for short durations required for access or housekeeping, light-sensitive objects in storage should be kept in total darkness. Lighting in the storage area should be turned off when not in use.

Figure 4.9. Maximum Acceptable Illuminance Level for Light Sensitive Materials[2]

3. Monitoring Light Levels

It is essential to measure the amount of light (both visible and ultraviolet radiation) present in areas containing museum objects, especially in museum exhibit spaces and furnished rooms of a historic structure. Measurements should be taken once a year, especially if any type of ultraviolet filters are in use. If the lighting equipment changes in a museum area, measurements should be taken at that time to ensure that the light stays within the recommended levels. If daylight is present in the room, light measurements should be taken seasonally both in the morning and the afternoon to record the change in sunlight as the sun moves across the sky.

a. Monitoring Equipment

Light meters always should be used to determine light levels because the eye easily adapts itself to whatever changes are occurring in the visible light and is, therefore, unsuitable for determining illumination levels. To get a true idea of ultraviolet radiation levels are is to measure visible light levels using a combination of a light meter and a UV monitor.

Several types of equipment are available to measure light levels. Types of and sources for light monitoring equipment are listed in the NPS Tools of the Trade.

The visible portion of the electromagnetic spectrum is measured using a light meter. Many types of light meters are available that measure light in lux or footcandles. When choosing a light meter, it is important to use a meter that is sensitive enough to measure light levels as low as 25 to 50 lux with a reasonable degree of accuracy (10% or better).

It is often necessary to measure ultraviolet levels in exhibit areas to make sure that any ultraviolet filtering materials are working. The Crawford UV Monitor is used for this purpose. This monitor reads directly in microwatts per lumen. The model used in the past has presented problems in determining an accurate reading. The reading depends on adjusting a knob until one red indicator light jumps to the other red light. The new model Crawford UV Monitor ensures improved accuracy by providing a reading on a direct analog scale.

When taking light readings with either the light meter or the UV monitor, a standard set of procedures should be followed. The sensor on the instrument should be aimed so as to catch the light hitting the object directly. Shadows from the hand or body should be eliminated. The sensor should be parallel to the surface of the object for two-dimensional objects (paper, paintings, photographs). For three-dimensional objects, the sensor should be aimed toward the light source. Light readings should be taken at various points on the object if it is larger than approximately 1 foot. Before using light monitoring equipment, carefully read the manufacturer's instructions for operation and maintenance.

b. Light Monitoring Program

In developing a light monitoring plan for museum spaces, the following information should be obtained and recorded.

All of the information recorded from a light monitoring program is important to determine if a lighting problem exists, what the cause might be, and what solutions should be used to correct this problem. The recorded information should be reviewed on a monthly basis and corrective measures taken as needed. The strategy for a light monitoring program is as outlined below.

1) Obtain and record the following information.

   a) Determine how the sunlight moves about the room in the course of the day. Determine the effect of artificial lighting used to supplement natural light or used to highlight certain objects in exhibit cases or on open display.

   b) In a historic structure, determine by studying the history of the structure what the past lighting conditions have been.

   c) Note the characteristics of existing lighting fixtures and filtering materials.

   d) Determine seasonal variations in light.

   e) Note the frequency of unusual events (e.g., filming in a historic structure).

2) Method for light monitoring program

   a) Evaluate the lighting conditions for each storage or exhibit space.

   b) Identify museum objects that are most susceptible to light damage.

   c) Establish monitoring sites within each space for the purpose of comparison. It is important that measurements be taken at the same sites and that the same procedures are employed during each monitoring session. Old sites can be abandoned and new sites established as conditions warrant. Prepare a floor plan for each storage or exhibit space that indicates the location of each monitoring site.

   d) Record all data on the Light and Heat Measurement Record illustrated in Figure 4.10.

   e) Note any corrective actions taken in the comments section of the Light and Heat Measurement Record (e.g., curtains drawn, historic awnings replaced, UV filtering film installed over windows and/or fluorescent tubes, electric voltage stepped-down because of historic wiring resulting in dimmer lights, light fixtures replaced).

3) Evaluating data from light monitoring program

   a) Identify those areas that meet the accepted museum standards for light levels. Determine how long light sensitive objects have been on exhibit. Determine whether those objects show signs of light damage. Remember that not all damage can be detected by visual inspection. It may be

necessary to consult the Regional Curator and/or a conservator.

b) Spaces housing sensitive objects that exceed the accepted light level standards are subject to corrective action. Once changes have been made, it is important to evaluate the results of those changes. For example: If UV filtering film is installed on glass window panes, monitor the UV radiation passing through the film and compare it with previous readings without the film. Does the film filter UV radiation? How much UV radiation has been eliminated? By installing UV filtering film on windows, how has visible light been effected? Does the visible light level exceed the standard?

c) Compare existing light conditions with historic lighting conditions. For example, do objects on exhibit receive more or less light than they did historically? Will reducing light levels in historic structure improve the interpretation of the building and the collection, as well as, being a beneficial preventive conservation measure?

d) Data collected by monitoring is hard data and therefore provides an important basis in any request for change or removal of threatened objects. Keep a permanent file of all light monitoring data.

4) Instructions for Using the Light and Heat Measurement Record

a) Identify the park and the structure in the appropriate blocks.

b) Enter the day, month, and year; and enter the time of day in the appropriate blocks.

c) Location Block: Building floor plans should be used in conjunction with the "Light and Heat Measurement Record". Specific light measurement sites should be identified on the floor plan with a number. A typical entry in the location column should identify the room and the measurement site.

d) UV Block: Direct readings of ultraviolet radiation can be taken with the Crawford UV monitor. If the reading is above 75 microwatts per lumen, corrective action is required.

e) Lux Block: Using a visible light meter, record the intensity of visible light in lux (lumens per square meter). If the meter reads in footcandles (lumens per square foot), convert footcandles to lux by multiplying by 10 (1 footcandle = 10.76 lux).

The accepted standard for museum collections is 50 to 200 lux depending on the materials which comprise the collection (Refer to Figure 4.9). Except where materials are insensitive to high light levels, measures will have to be initiated when these levels are exceeded.

f) Room Temperature Block: Enter the air temperature (°C) for the particular location using a thermometer or by noting temperature readings on the chart of a hygrothermograph. Note: Temperature readings on a hygrothermograph chart are in °F. Use the formula °C = (°F -32) x .555 to convert readings to °C.

g) Object Temperature Block: Enter the surface temperature (°C) of objects. Hold a portable infrared thermometer near the surface of an object that is exposed to direct sunlight or locally illuminated by artificial lighting fixtures. Do not allow the thermometer to come in contact with the object's surface. Consider exhibit case environments and objects situated near heating and ventilation ducts as well as objects located on exterior walls. This measure aids in the identification of localized heating or potential condensation sites.

h) Light Source, Weather, and Comments Block: Record information concerning the quality and the source of illumination, corrective measures, and weather conditions (e.g., overcast, rain, sunny). Record any unusual circumstances in this block.

c. Monitoring Light Damage to Sensitive Objects

A method of illustrating light damage in a particular exhibit area is by using Blue Wool light standards. Blue Wool light standards are specially dyed textiles that are made so that the most sensitive standard textile sample will fade in just half the time needed to match the next most sensitive standard. There are eight of these samples to a set. To determine whether fading is taking place in a museum area and how quickly, one set of the light standards should be placed on the wall in the exhibit and another set in total darkness. Another method is to cover half of the standard vertically in the exhibit with aluminum foil. By comparing the two sets of standards or the two halves of one set, it can be determined if any fading is taking place.

4. Controlling Light Levels

Since all light is damaging to museum objects and this damage is cumulative, all light must be controlled in museum areas that contain museum objects.

NATIONAL PARK SERVICE
LIGHT AND HEAT MEASUREMENT RECORD

PARK: ______________________ STRUCTURE: ______________________

Date	Time	Location	UV Reading	LUX Reading	Room Temperature	Object Temperature
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						

Figure 4.10. Light and Heat Measurement Record

a. Light (Visible Spectrum)

Light, whether it is natural or artificial, must be maintained within the recommended light levels indicated in Figure 4.13. These levels can be obtained using a variety of control methods.

One method for controlling natural light coming in through windows is to use window coverings such as blinds, shades, curtains, shutters or exterior awnings. These devices should be closed whenever possible to prevent entrance of light into the museum spaces. Schedules can be worked out to open these devices when visitors are present and natural daylight is needed for tours. Another technique is to use dust covers to cover light sensititve objects (including floor coverings). Dust covers for light sensitive objects should be made of opaque materials such as cotton muslin or Gortex®. Both of these materials block light. Dust covers should be used whenever visitors are not present for extended periods and are particularly useful in storage areas and furnished room exhibit areas that are not open to the public on a year-round basis.

Tinted light filters (films or glazings) also can be placed on windows or over artificial lighting to lower light levels. However, some tints have bronze or silver reflecting surfaces and are considered to be inappropriate for use and are visually obtrusive on historic structures. Special care should be taken to choose tints that will not call attention to the windows or create a negative impact on the historic scene. Refer to the NPS <u>Tools of the Trade</u> for sources of light filtering materials.

Artificial light levels can be reduced by using colored filters, lowering the wattage of the incandescent bulbs, using fewer light fixtures, using flood light bulbs instead of spots, and turning off the artificial lighting when people are not present. Electrical switches can be used in exhibit areas that activate lighting in specific areas only when a button is pressed or when a person is present. A timer can be attached to the switch so that the light will stay on for only a specific period.

b. Ultraviolet (UV) Radiation

Ultraviolet radiation must be eliminated as much as possible. It can be controlled using the techniques recommended for controlling light levels. All lighting except incandescant lighting should be filtered by installing filtering materials (e.g., plastic solar control film for windows, UV filtering sheet for windows or picture frames, and filter sleeves for fluorescent tubes) between the light source and museum objects. Ultraviolet filtering material should always be placed over fluorescent tubes. Fluorescent tubes are now available that have been coated in an ultraviolet filtering chemical. Refer to the NPS <u>Tools of the Trade</u> for sources of UV radiation filtering material.

In UV filtering materials, the plastic material on which the chemical coating is attached to tends to break down faster than the filtering chemical itself. Filters should be replaced whenever they physically begin to breakdown (turn yellow, crack), as well as when the ultraviolet filtering chemical ceases to work. Monitor UV radiation at least every five years to ensure that the filtering material continues to be effective. High pressure mercury and sodium lamps should not be used in museum areas that contain museum objects because they emit high levels of ultraviolet radiation.

c. Infrared (IR) Radiation

Infrared radiation (heat) that is generated by natural or artifical lighting also must be controlled to prevent rapid changes in relative humidity or possible risk of fire. Heat generated by natural lighting can be controlled through use of window coverings, window filters and good air circulation systems (e.g., fans, air conditioners). Heat produced by artificial lighting can be controlled by using light filters, good air circulation systems, and physically separating lighting fixtures from the section of exhibit cases that contain museum objects.

If the light fixtures for an exhibit area are in an enclosed box, this box should be well vented to the general exhibit area to prevent heat buildup. Dimmers that operate light bulbs at a lower level when the heat buildup becomes excessive should always be used.

One of the major causes of excessive heat buildup in museum areas is artificial lighting for photography, especially the lighting used for filming motion pictures. Strong flood lamps for professional photography can be a serious heat problem. Methods of heat control in these situations include using heat-absorbing light filters and making sure the area in use is well-ventilated with fans or air conditioners. The strong lighting should stay on only when actual filming is taking place and be turned off in between takes and during rehearsals. If rehearsals with lighting are necessary, dummy objects should be used.

F. DUST AND GASEOUS AIR POLLUTION

1. Introduction

Air pollution in the form of dirt and smoke (e.g., soot, ash) has been a problem in urban areas since the 19th century. In this century, industrial emissions, automobile exhausts, and domestic heating by-products have increasingly contaminated the air with numerous chemical compounds that cause deterioration of museum objects. Today, air pollution problems for museum collections are no longer confined to urban areas. Air pollution has become a serious threat to buildings, monuments, and works of arts (e.g., stone and metal statuary), especially those in outdoor settings. Indoor environments also generate air pollutants that can cause object deterioration. Wood, especially plywood and particle board, emit formaldehyde, formic acid, and acetic acid. Some humidifiers release gases and mineral particles into the air. Air pollutants are classified into two types: particulate and gaseous. This section focuses on the concerns of air pollutants in the indoor environment.

Particulate pollutants include dirt and dust. Composed of minute mineral particles (e.g., silica, iron oxide), dust can be an abrasive agent. Dust also includes skin cells and pollen. When water condenses around particulates, some of them become active chemical agents that directly attack museum objects. Dust often disfigures objects by soiling the surface. Methods for removing dust involves washing, wiping, or shaking which accelerate deterioration and increases the risk of physical damage. Dirt attracts insects and is often acidic. In coastal areas, the air contains chloride salts that are often highly corrosive. Ground soil is a particular concern for archeological objects. Water soluble salts (e.g., sodium chloride, sulfates, phosphates, and nitrates) contained in the soil tend to infuse in ceramic and other porous materials. After removal from the ground, these salts may crystalize on the surface in drier conditions eventually destroying the physical structure of the object.

Gaseous pollutants include, or combine to produce, strong corrosive or oxidizing agents. Metals, stone, and most organic materials (e.g., paper, textiles, leather) are particularly suceptible to gaseous pollutants. Some of these pollutants attract water which facilitates harmful chemical reactions. Ozone, generated by electrical equipment or by the action of sunlight on automobile exhaust emissions, reacts with most organic materials, weakening cellulosic materials (e.g., paper, textiles), discoloring dyes, and deteriorating varnish and oil paints. The air inside exhibit cases may be polluted with organic acids (e.g., formaldehyde, acetic acid) from wood products (e.g., plywood, particle board) or by sulfur-containing solvents liberated from unsuitable paints, fabrics used for display backgrounds, or from rubber gaskets. These pollutants can cause silver to tarnish, bright copper to discolor, lead to become coated with a white powdery encrustation, and leaded bronze to grow crystals. Often the result is structural deterioration.

2. Gaseous Pollutants

Gaseous pollutants include the acidic compounds of sulfur dioxide (SO_2) and nitrogen dioxides (NO). These acidic gases convert to acids when they combine with moisture. This change occurs either in the atmosphere or on the surface of an object. If acid is formed in the atmosphere, it can then be directly deposited on surfaces of materials located in outdoor settings exposed to rain, snow, and dew. In the presence of a catalyst (e.g., a particle containing a heavy metal) and moisture, acid is created.

Some sulfur dioxide is emitted by natural biological processes, however, high concentrations are generated by burning fossil fuels and sulfur bearing ores. Materials most affected by sulfur dioxide are paper, textiles (natural and synthetic fibers), leather, stone (marble and limestone), metals (iron and steel), paints, and photographic materials. Paper, cotton, wool, silk, and leather may become embrittled and discolored. Sulfur dioxide accelerates the rusting of iron. High levels of relative humidity and light accelerate the reaction time of these materials with the SO_2.

Sulfur dioxide combines with oxygen in the presence of a catalyst to form sulfur trioxide which readily attracts moisture. Then, sulfur trioxide can combine with moisture to form the strong and damaging sulfuric acid. Rain in areas with high levels of sulfuric acid in the air will be highly acidic. Once on a surface this agent tends to remain in place causing much surface damage.

Nitrogen oxide (NO) and nitrogen dioxide (NO_2) are the products of any type of combustion. These gases readily convert from one to the other and are indistinguishable to monitoring devices. They oxidize in the presence of moisture to produce nitric acid or nitrous acid. This agent is less damaging than sulphuric acid because it is more volatile.

Damage to materials by nitric acid includes the weakening of textile fibers and the fading of textile dyes.

The most damaging gaseous pollutant is ozone. Ozone is generated naturally in the earth's upper atmosphere, by photochemical smog (e.g., automotive exhausts and sunlight), and by electrical or lighting equipment (e.g., electrostatic photocopying machines, certain types of air filtering equipment).

Ozone reacts with rubber, textiles and plastics, and causes deterioration to almost all organic materials. It causes fading of textile dyes and artists' pigments, particularly watercolors.

3. Particulate Pollutants

Particulate pollutants consists of solid particles suspended in the air. These particles include dirt, dust, pollen, and skin cells. They vary enormously in size and their diameter can be measured in

microns. The size of the particulate matter is important when trying to determine what size air filters to use in a specific building. Particulate matter is especially dangerous to objects because it attracts moisture and gaseous pollutants. It is also destructive when allowed to settle on objects because it can cause mechanical damage (e.g., scratches). Because of the levels of gaseous pollution now present in most areas of the world, it is unacceptable to allow dust to collect on museum objects.

Particulate matter plays three basic roles in relation to gaseous pollutants:

a. It is a source for sulfates and nitrates. These particles can readily become acidic on contact with moisture.

b. It provides a catalyst for the chemical formation of acids from gases.

c. It is an attractant for moisture and gaseous pollutants. When particles absorb moisture from the surrounding air, they also may attract sulfur dioxide or nitric dioxide.

Particulate matter comes from both outdoor and indoor sources and includes smoke, soot, ash, and dust. Outdoor sources include the burning of fuels in power stations, automobile exhaust, pollens, and dirt from construction sites. Indoor sources include textile fragments, skin cells, smoking, deteriorating building materials, and unsealed concrete.

4. <u>Sources of Indoor Pollutants</u>

a. Building Materials

Dust from building materials may include minute alkaline particles from unsealed concrete, formaldehyde resins used in plywood and particle board, and adhesives/glues.

b. Pollutants Introduced by Heating, Ventilation, and Air-conditioning System

Outdoor pollutants are brought indoors in large quantities through a structure's heating, ventilation, air-conditioning system (HVAC) making pollution filtration systems important in controlling the amount of pollution found within a structure. The HVAC system can circulate pollutants from other spaces in a structure if the air intakes are not properly installed and operated.

c. Museum Objects

Some museum objects are responsible for polluting the indoor air because they are made up of materials that emit gases. Examples include celluloid and other unstable plastics, cellulose nitrate and diacetate negatives and pyroxylin impregnated cloth used in

Twentieth Century book binding. Objects treated with a fumigant (e.g., ethylene oxide) also may emit residual gases.

d. Exhibit and Storage Materials

Many construction materials give off potentially harmful gases and can create unsuitable environments inside exhibit cases and storage cabinets. The problem is made worse when cases and cabinets are sealed tightly, allowing pollutant levels to build up inside. Among the more common sources of this type of air pollution are fabrication adhesives, which may release formaldehyde; many woods (e.g., oak), which may release acidic vapors; rubber products, which may release sulfides; and paints and varnishes (e.g., oil-based), which may release acids and volatile additives. Control of the environment inside exhibit cases and storage cabinets can be achieved by carefully choosing materials and using them in well designed construction.

Figure 4.11 illustrates the types of deterioration caused by air pollution agents to certain types of object materials.

Object Materials	Deterioration	Primary Air Pollutants	Environmental Factors Accelerating Damage
Metals	Corrosion/Tarnishing	Sulfur Oxides and Other Acid Gases	Water, Oxygen, Salts
Stone	Surface Erosion, Discoloration	Sulfur Oxides and Other acid gases, Particulate Matter	Water, Temperature, Fluctuations, Salt, Vibration, Microorganisms, Carbon Dioxide
Paint	Surface Erosion, Discoloration	Sulfur Oxides, Hydrogen Sulfide, Ozone, Particulate Matter	Water, Sunlight, Microorganisms
Textile Dyes and Pigments	Fading, Color Change	Nitrogen Oxides, Ozone	Sunlight
Textiles	Weakened Fiber Strength, Soiling	Sulfur Oxides, Nitrogen Oxides, Particulate Matter	Water, Sunlight Mechanical Wear
Paper	Embrittlement	Sulfur Oxides	Moisture, Mechanical Wear
Leather	Weakening, Powdered Surface	Sulfur Oxides	Mechanical Wear
Ceramics	Changed Surface Appearance	Acid Gases	Moisture

Figure 4.11. Deterioration to Museum Objects Caused by Air Pollution

5. <u>Monitoring Levels of Air Pollution</u>

The concentration of both particulate and gaseous pollutants contained in a volume of air is measured in micrograms per cubic meter. Measurements of pollutant levels requires very sensitive and expensive instruments. If observations indicate that air pollution may be causing damage to objects in a park's museum collection, contact the Regional Curator for assistance in obtaining measurements.

There are several steps that can be taken by the curatorial staff in identifying air pollution levels.

a. Inspect storage spaces (e.g., floors, open shelving, tops of cabinets and tables) for dust. Record time frame for build-up of dust since last dusting. Look for increased insect activity. Such activity is often related to an unacceptable accumulation of dust.

b. In coastal areas, (e.g., museum facilities located within one mile of the ocean) watch for chloride pollution in museum spaces by observing and noting active corrosion on metal objects. Chlorides will attack unpainted iron or steel objects. Inspect all bronze objects for evidences of "bronze disease" - a pale green, powdery corrosion.

c. Parks, through ongoing research on air quality, may have recorded information. Contact the Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards to obtain information on the levels of ozone, sulfur dioxide, nitrogen dioxide and particulates recorded in the park. These data will assist park staff in identifying potential pollutant problems that may exist in the park. Areas with high concentrations of gaseous pollutants in the air will definitely want to establish a program for monitoring signs of active deterioration on objects in museum storage and exhibit areas.

d. Because the presence of water accelerates the effects of particulate and gaseous pollutants on objects, relative humidity data being recorded in museum spaces is essential to monitoring air pollution.

e. Observe and record the nature of internal air control systems and the nature of the structure housing the collections. Adobe and concrete walls are sources of high levels of dust. Air intakes, not properly filtered, may convey high levels of pollutants into a museum space. Exhibit cases, storage cabinets, shelving made of untreated wood or painted with improper paints may outgas increased levels. In addition, observe how much dirt and dust is brought into spaces by employees and visitors.

6. <u>Methods for Controlling Air Pollution</u>

The NPS standard is as follows: Eliminate gaseous and particulate pollution to the lowest practical level. There is no minimum acceptable level of pollution. Suggested methods for controlling air pollution in museum spaces are as follows:

a. In storage spaces, keep floors, tops of cabinets, and work surfaces clean to minimize accumulation. Incorporate dust control into the housekeeping program. Separate office and curatorial work spaces from museum collections storage spaces.

b. Upgrade and maintain seals and weather stripping around doors and windows.

c. Store all sensitive objects in appropriate museum specimen cabinets. Maintain sound gaskets on all storage cabinets. Replace old gaskets with neoprene gaskets. Refer to NPS Tools of the Trade for the source of retrofit gasket kits. NPS Conserve O Gram 4/8 provides guidance on installing the retrofit gasket.

d. Use dust covers to protect objects on open shelving. Dust cover material should be chemically and physically non-damaging and provide as complete a dust seal as possible while allowing easy accessibility. Use clear polyethylene sheeting or unbleached cotton muslin material. Refer to NPS Conserve O Gram 4/7, "Dust Covers for Steel Shelving."

   The polyethylene and the cotton muslin each have advantages and disadvantages. Polyethylene is an impenetrable barrier to dust and moisture and is clear, thus facilitating inspection of objects without having to open the covering. The disadvantages are that it is not flameproof and can lead to condensation in fluctuating environments. Cotton muslin may be made flameproof but does not allow viewing of the artifacts without opening the covering.

   Two new non-woven materials: "Tyvek® style 1621C," a spun polyethylene sheet, and "Gore-Tex® 1.3 oz. Barrier," a laminate of a teflon membrane with a polyester backing, may be used as dust covers. Both new materials are flexible, dustproof, waterproof, opaque, and allow air circulation. A disadvantage is that neither material is flameproof. Another disadvantage of Gore-Tex® 1.3 oz. Barrier is its high cost.

   There are a number of methods for attaching the covering material to the shelving. One recommended method is to affix the covering to shelves and uprights with spring clips. Spring clips may be obtained from GSA by using FSN 7510-00-223-6807 or from a local office supply store. Velcro®, the hook and loop fabric fastener, may also be used to affix dust covers. Velcro® with a pressure sensitive adhesive backing may be purchased at hardware and office supply stores.

e. Segregate objects that outgas inherent pollutants (e.g., cellulose nitrate negatives, diacetate negatives) from all other objects. Store them in separate cabinets.

f. Store, exhibit, or transport objects in appropriate cases. Avoid using exhibit materials (e.g., oak, douglas fir) that outgas organic acids (e.g., formaldehyde). The adhesives used in plywood and veneers may be a source of pollutants. Harmful materials include protein based glues, wools, vulcanized rubber, cellulose nitrate, polyvinylchloride, and polyurethanes. Refer to Figure 4.12 for a list of both harmful and safe materials.

Materials Known to Release Harmful Vapors	
Materials	Harmful Vapors
Wood (particularly oak, birch, beech)	- Organic acids
Protein-based glues, wool	- Volatile sulfides
Vulcanized rubber	- Volatile sulfides
(Some dyes may release sulphur compounds)	
Cellulose nitrate	- Oxides of nitrogen
Polyvinyl chloride	- Hydrochloric acid
Polyurethanes are suspect	

Materials that Appear to be Safe

Metals
Glass
Ceramics
Inorganic pigments
Polyethylene and polypropylene
Acrylic solutions (not necessarily emulsions)
Polyester fibers
Cotton and linen

Figure 4.12. Materials Known to Release Harmful Vapors and Materials that Appear to be Safe[3]

7. Conditioning System

Filters in an air-conditioning system may be effective in reducing levels of air pollution. However, except in the most rigidly designed system, it is not practical to eliminate all particulates because very high pressures are necessary to force air through the filtering system.

Filtering systems work best when air is filtered at two points in the air flow system. The first filter should be a "viscous filter." This filter is placed downstream or where air is taken into near air intake to the structure. These filters use a liquid such as oil to trap coarse particulates. The next filter should be a "fabric filter" (layers of fabric). These are more efficient in removing particulates. Remember: To be effective, filters need to be routinely cleaned or changed.

An air-conditioning system for museum collection storage spaces should be independent from other systems in the structure. Never use "electrostatic precipitators" in a space housing museum objects. These precipitators, though effective, generate ozone. The rate of ozone production is not known.

Effective control of gaseous pollutants by air-conditioning requires highly specialized design and engineering. Such systems may use water sprays or activated charcoal filters to remove gaseous pollutants. Activated charcoal is most effective in removing the damaging pollutant sulfur dioxide. It is not as effective in filtering out the oxides of nitrogen. This system also requires elaborate equipment for monitoring pollutants.

8. Portable Filtering Equipment

Portable air purifiers that have activated-carbon filters may be used to clean air of particulates. Refer to the NPS Tools of the Trade for sources of this equipment.

G. SELECTED BIBLIOGRAPHY

Canadian Conservation Institute
1988 "Ultraviolet Filters for Fluorescent Lamps," Canadian Conservation Institute (CCI) Notes 2/1. Ottawa, Canada: Canadian Conservation Institute.

Carpenter, Jane and Hatchfield, Pamela
1987 Formaldehyde: How Great is the Danger to Museum Collections? Cambridge, MA: Center for Conservation and Technical Studies, Harvard University Art Museums.

Cumberland, Donald C., Jr.
1985 "Dust Covers for Steel Shelving," NPS Conserve O Gram 4/7. Washington, D.C.: Curatorial Services Division

______________.
1988 "Calibration of Hygrometers and Hygrothermographs," NPS Conserve O Gram 3/16. Washington, D.C.: Curatorial Services Division.

De Guichen, Gael
1988 Climate in Museums: Measurement (Third Edition). Rome: International Center for the Study of the Preservation and Restoration of Cultural Property (ICCROM).

Feller, Robert L.
1964 "The Deteriorating Effects of Light on Museum Objects," Museum News, Technical Supplement (June), 3:i-viii. Washington, D.C.: American Association of Museums.

Jessup, Wendy Claire
1990 "Conservation: A Basic Overview for the Exhibit Specialist," Exhibitionist (Summer), 15-19. Washington, D.C.: National Association for Museum Exhibition; Standing Professional Committee on Museum Exhibition of the American Association of Museums.

La Fontaine, Raymond H. and Wood, Patricia A.
1982 Fluorescent Lamps. Technical Bulletin No. 7 (Revised Edition). Ottawa, Canada: Canadian Conservation Institute.

Paine, Shelley Reisman
1985 Technical Report 3: Basic Principles for Controlling Environmental Conditions in Historical Agencies and Museums. Nashville, TN: The American Association for State and Local History.

Padfield, Tim; Erhardt, David; and Hopwood, Walter
1981 "Trouble in Store", Science and Technology in the Service of Conservation, 24-27. Washington, D.C.: Reprints of the International Institute of Conservation Conference.

Royal Ontario Museum
1979 *In Search of the Black Box, A Report on the Proceedings of a Workshop on Micro-Climates Held at the Royal Ontario Museum, February 1978*. Toronto, Ontario, Canada: The Royal Ontario Museum.

Sheetz, Ron and Fisher, Charles E.
1990 "Reducing Visible and Ultraviolet Light Damage to Interior Wood Finishes," *Preservation Tech Notes*, Museum Collections, Number 2. Washington, D.C.: National Park Service, Preservation Assistance Division.

Stolow, Nathan
1987 *Conservation and Exhibitions: Packing, Transport, Storage and Environment Considerations*, Chapter 2, "Conservation Principles," 4-24. Stoneham, MA: Butterworths.

Thomson, Garry
1986 *The Museum Environment* (Second Edition), "Light," Part I, 2-64; "Humidity," Part I, 66-127, and "Air Pollution," Part I, 130-162. London: Butterworths.

Thomson, Garry and Bullock, Linda
1985 *Museums Information Sheet*, "Conservation and Museum Lighting." Great Britain: Museum Associations.

Thompson, John M. A. (Editor)
1984 *Manual of Curatorship*, Chapter 26, "Environmental Conservation," 192-202. London: Butterworths.

Weintraub, Steven and Anson, Gordon O.
1990 "Natural Light in Museums: An Asset or Threat?," *Progressive Architecture* (May), Technics. Stamford, CT: Penton Publishing.

H. ENDNOTES

1. Relative humidity optimum ranges for materials included in Figure 4.3 are based on information from Climate in Museums: Measurement (Third Edition) by Gael De Guichen and on information included in curatorial care appendices of this handbook.

2. Illumination levels included in Figure 4.9 are based on information in The Museum Environment (Second Edition), "Light," Part I by Garry Thomson.

3. Information included in Figure 4.12 is taken from Trouble in Store by Padfield, Erhardt, and Hopwood.

4. The ABC's of Air Conditioning: A Primer of Air Conditioning Types and Methods outlines the types of air conditioning systems, introduces cooling load calculation, and compares the functioning of system types. A copy of this publication may be obtained from:

   Carrier Air conditioning
   P.O. Box 4800
   Syracuse, NY 13221
   315/432-6000

5. The Humidification Handbook: What, Why, and How written by Bernard W. Morton includes an introduction to humidity theory and measurement, and provides specific information on the determination of humidification load, methods of humidification and system design considerations. A copy of this publication may be obtained from:

   Dri-Steem Humidifier Company
   P.O. Drawer 128
   Hopkins, MN 55343
   612/935-6986

6. The Cargocaire Dehumification Handbook discusses methods of dehumidification, system design and selection, and provides an introduction to calculation of moisture loads. A copy of this publication may be obtained from:

   Cargocaire Engineering Corporation
   79 Monroe Street
   P.O. Box 640
   Amesbury, MA 01913
   617/388-0600

CHAPTER 5. BIOLOGICAL INFESTATIONS

Page

A. INTRODUCTION TO BIOLOGICAL INFESTATIONS

1. The Problem

a. Museum Pests

Museum collections are vulnerable to damage and deterioration caused by a variety of biological organisms. The damage can range from surface soiling and spotting to complete destruction of the object. While organic materials (e.g., silk, skin, wool, hair, hide, paper and wood) are most vulnerable, inorganic materials (e.g., metals, glass, and stone) may also be damaged by biological agents. However, the mechanism that causes damage to inorganic materials is very complex, is rarely seen in museums, and is beyond the scope of this handbook.

Pests that damage museum collections can be divided into three categories:

- Microorganisms (e.g., mold and fungi)
- Insects
- Vertebrates (e.g., birds, and mammals such as rats, mice and bats).

The three categories are interrelated. They can support each other's survival and can contribute to the damage caused by each other.

Unfortunately, the optimum conditions for the care, storage and exhibition of museum collections is also ideal for the survival of museum pests. However, improper storage and exhibition conditions, such as high temperatures, high relative humidity levels, dust, overcrowding and clutter, serve to further improve the conditions for pest survival.

b. Traditional Control Measures

The traditional method for controlling pests in museums has been either the routine prophylactic treatment of collections with pesticides such as arsenic, thymol, mercury, DDT, ethylene oxide, Vapona (DDVP), naphthalene, and paradichlorobenzene (PDB), or treatment with these same chemicals once an infestation has been discovered. Recent studies have found that these chemicals can damage museum objects and can cause health problems for museum staff. Furthermore, improper application of pesticides has caused insect resistance to some of these chemicals that may have led to a false sense of security that the treatment has been effective.

2. Integrated Pest Management

Integrated Pest Management (IPM) is an ecosystem approach to the control of pests. In contrast to the traditional control measures against museum pests, IPM employs a variety of approaches to prevent

and solve pest problems in the most efficient and ecologically sound manner without compromising the safety of the collections or staff. It is information-intensive about the pest, its habits and ecology, and the environment in which the pest thrives and survives. IPM is site-specific and adaptable to any museum environment. IPM also provides a structure in which responsible decisions concerning the treatment of pest problems can be made.

The goal of IPM for museum collections is two-fold:

a. To protect the museum and its collections from pests which damage the collections; and,

b. To reduce the amount of pesticides used in the collections because pesticides have been found to damage collections and cause health problems for museum staff and visitors.

The National Park Service Integrated Pest Management program is a Servicewide program established in 1980 in response to a Presidential memorandum directing all Federal agencies to adopt IPM into their management policies. A copy of the Presidential memorandum and excerpts from DOI and NPS policies on IPM are included in Appendix A. NPS-77, Natural Resources Management Guideline, provides guidance on pesticide use in the National Park Service and a structure for obtaining approvals for the use of pesticides.

Each region has an IPM coordinator who reviews applications for pesticide use prior to forwarding them to the Associate Director, Natural Resources. The Regional IPM Coordinator and the Regional Curator are available to assist in developing IPM plans and strategies for dealing with museum pest problems. Training in IPM is developed through the Associate Director, Natural Resources and regional offices.

B. IDENTIFYING MUSEUM PESTS

This section contains specific information on the different types of pests, their descriptions, habits, and ecology.

1. Microorganisms

Accurate identification of microorganisms can only be made by a trained mycologist. For museum pest management, evidence of mold, fungi and other microorganisms indicates that the environment is appropriate to support their growth and may be inappropriate for the preservation of museum collections.

The spores of mold and fungi are omnipresent: they are in the air we breath, on the food we eat, and they are in and around our collections at all times. They will become active when the temperature and relative humidities are appropriate and when nutrients are available to support their growth. Mold has been found growing at temperatures between 32 and 100? F, and when the RH exceeds 65%. Unfortunately, the materials of museum collections (e.g., paper and sizing solutions in paper, animal glue, adhesives, starch pastes) can often provide nutrients for mold and fungi to flourish if environmental conditions are appropriate for the spores to germinate. All organic materials are prone to damage by mold. The damage can range from odor formation and staining to structural weakening and complete destruction of the object.

Mold and fungi present the greatest problems in tropical areas where ambient conditions (e.g., moisture and heat) are conducive to mold growth. In temperate climates, evidence of mold and fungi usually indicates that there is a problem with the environment and modification of the climatic conditions will usually correct the problem.

While specific identification of the mold species is not usually necessary to determine a treatment strategy, a key to the most common molds found in tropical climates is listed in Chapter 3, "Combatting the Moulds Which Develop on Cultural Property in Tropical Climates" by Roger Heim, Francoise Flieder and Jacqueline Nicot, in The Conservation of Cultural Property, UNESCO, 1968, pp. 42-44.

2. Insects

Not all insects found in the museum will damage the collections. However, it is important to identify every insect found in the museum to determine if it is a threat to the collections.

Insect pests of museum specimens can be divided into categories based on the primary type of materials on which they live or feed. The categories are as follows:

- Mold Feeders
- Woodborers
- Cellulose Feeders
- Protein Feeders
- Starch Feeders

There are also some insects (e.g., cockroaches and crickets) that are omnivorous. Members of these groups have been found to damage a wide variety of organic materials. Furthermore, there are certain insects that do not feed on the museum object, but damage it by other means--excreting, soiling or burrowing to find a quiet place to develop into the next life stage. The above terminology is consistently used within the museum field and has become incorporated into the terminology of this specialized area. These terms may have a different connotation outside of the museum field; and, therefore, they should be used with caution in talking with entomologists or pest control specialists not directly associated with the museum profession.

Structural pests (e.g., subterranian termites, carpenter bees and carpenter ants) may threaten museum collections. While beyond the scope of this chapter, these pests must be identified and action must be taken to control them. Refer to NPS IPM Packages XXXIVA, Structural Pests for Termites and XXXIVB, Structural Pests II for Carpenter Ants and Carpenter Bees.

The following pages provide a list by host type with brief descriptions of the most common insects that can be pests of museum collections. Parks should obtain a copy of the book A Guide to Museum Pest Control that is listed in the selected bibliography of this chapter. Section II. "Pests and Pest Identification," pp. 53-81, provides illustrations of all the insects described in this section.

The Mold Feeders

Common Names: **Booklice; Psocids**

Scientific Name: Liposcelis spp.

Description: 1 to 2 mm in length; pale gray or light brown; nymphs are transluscent, becoming more opaque as they age. No wings.

Damaging Stage: Nymphs and adults

Materials Damaged: Glues of books and sizing of textiles. Psocids are surface "grazers," demonstrating little evidence of direct damage, except to grains, cereals and stored products. Have been found to cause some damage to dried insect specimens.

Ecology/Habits: Booklice undergo incomplete metamorphosis (egg, nymph and adults) and reproduce parthenogenically; between 20-90 eggs are laid with life cycle varying between 24-110 days depending upon environment and species; possibly six to eight generations per year. Normally booklice are found outdoors living in damp and decaying vegetation where adults and nymphs die with the onset of winter but the eggs can survive. They are most numerous in spring and summer especially in damp climates. These organisms can enter the museum on any material, particularly if the material has been in damp locations. They are known to feed on microscopic molds that develop on or around hygroscopic materials. Booklice also have been found in herbaria and insect collections.

References:

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982, pp. 311-318.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985, pp. 15-16.

Common Name: **Drywood Termites**

Scientific Names: Kalotermes, Incisitermes, and Cryptotermes spp.

Description: Colors and sizes vary from species to species and from caste to caste. Fecal pellets are hard, oval, approximately 1 mm in length and have six concave surfaces.

Damaging Stage(s): Nymph and Adult Workers

Materials Damaged: Wooden furniture, wooden structures. Hardwood and softwoods; seasoned and unseasoned. Will damage adjacent non-wooden materials such as books, paper, and textiles.

Ecology/Habits: Undergoes incomplete metamorphosis. Live within relatively dry, non-decayed wood. These termites do not require contact with the soil. Infestation is spread through the movement of infested materials or by winged reproductives establishing new colonies. They do not require high amount of moisture in which to survive. Drywood termites are social insects and live in colonies where the populations are divided into different castes which perform different functions. Nymphs care for other castes and maintain the nest. Tunnels in wood often cut across the grain.

References:

NPS Integrated Pest Management Information Package XXXIVa

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982, pp. 200-205.

The Woodborers

Common Names: **True Powderpost Beetle; Lyctid Powderpost Beetles**

Scientific Name: Lyctus spp.

Description: Adults are reddish-brown to black and 2 to 7 mm in length. Frass is a very fine powder. Holes produced by emerging adults are small (approximately 1-2 mm in diameter) and round. Larvae are white and have an enlarged spiracle on either side of the abdomen near the end of the body.

Damaging Stage(s): Adult and larva, although the larva does most of the damage. The adult only makes a hole as it exits from infested materials.

Materials Damaged: Seasoned and partly seasoned, unfinished sapwood of hardwoods where the moisture content of the wood is between 6 and 40%. Oak, maple, walnut, ash, and hickory are preferred woods. Other woods sometimes damaged include magnolia, birch, poplar, sycamore and cherry. Bamboo is also a favored food. Historic structures; furniture; wooden implements; gunstocks; baskets and bamboo materials are also damaged. Materials with painted or sealed surfaces are less prone to attack.

Ecology/Habits: Undergoes complete metamorphosis. The adult female deposits her eggs in the open pores of wooden materials. If infested wood is used in the manufacture of an object, the adult can emerge through a finished surface and provide an opening in which eggs can be deposited. Adults are active at night. Lifecycle ranges from 1 to 4 years. Depending upon the temperature and moisture content of the wood, the larval stage can last as long as 9 months. Larvae tunnel through wood along the grain. Pupation occurs in the larval tunnels usually near the surface.

References:

NPS Integrated Pest Management Information Package XXXIVb

Mallis, Arnold, The Handbook of Pest Control, Franzak and Foster, 1982. pp. 279-283.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 43-44.

The Woodborers

Common Names: **Furniture Beetle; Anobiid Powderpost Beetle**

Scientific Names: Anobium punctatum (DeG.); Anobium striatum (Oliv.)

Description: The adults are cylindrical and between 4 and 6 mm in length. They are reddish-brown to dark brown in color and the wing covers appear to have longitudinal rows of punctures. The frass consists of hard oval pellets. The exit hole produced by the emerging adult is round and about 2 mm in diameter. The egg is white, oval and less than 1 mm in length. The larva is about 6 mm long. It is white with black jaws and has three pairs of legs. On the back of the larva are double rows of brown spines.

Damaging Stage(s): Larva

Materials Damaged: The sapwood of softwoods. Furniture, wooden structural members; books.

Ecology/Habits: Undergoes complete metamorphosis. Depending upon the moisture content of the wood on which they are feeding, the life cycle can last as long as 2 or more years. Eggs are laid singly or in small groups in the crevices or exit holes of wood and hatch in about one week. The female is more likely to deposit eggs in rough, unfinished wood, than in smooth, painted or varnished surfaces. Areas of high relative humidities and warmer temperatures are most conducive to the development of an infestation.

References:

NPS Integrated Pest Management Information Package XXXIVb

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 283-286.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 39-41.

The Cellulose Feeders

<u>Common Name</u>: **Cigarette Beetle**

<u>Scientific Name</u>: <u>Lasioderma</u> <u>serricorne</u> (Fab.)

<u>Description</u>: Adults are small, approximately 2.5 mm (approximately 1/10") long, oval and reddish yellow or brownish red. From the dorsal view, the head is completely hidden by the thorax. The elytra or wing covers are smooth. The antennae are sawlike or toothed. The larvae are dirty white and hairy with brown head capsules. The larvae grow up to 4 mm in length.

<u>Damaging Stage(s)</u>: Adult and larva, the larvae are more destructive.

<u>Materials Damaged</u>: Books; paper; cellulosic textiles; basketry; herbarium specimens; spices; seeds; grains; furniture upholstered with flax tow or straw; may damage some proteinaceous materials like silk and has been found feeding on insect specimens, fish meal and leather. Has also been found feeding on grain-based rodent baits.

<u>Ecology/Habits</u>: Undergoes complete metamorphosis. Life cycles are usually 70 to 90 days in length depending on environmental conditions. The female adult lays between 30 and 100 eggs in undisturbed food materials. The eggs hatch in 6-10 days depending upon the temperatures. The larvae are active at temperatures above 60°F and will feed for 5-10 weeks, passing through two to four instars. Larvae are photophobic, will tunnel through materials and create a "chamber" from bits of the food source in which to pupate. Pupation usually takes about 1 week. Outdoors, the cigarette beetle overwinters in the larval stage. The adults live for approximately 2-6 weeks. They are strong fliers and like the larvae, shun light. They are most active in the late afternoon and on cloudy days.

<u>References</u>:

NPS Integrated Pest Management Information Package XVI.

Mallis, Arnold, <u>Handbook of Pest Control</u>, Franzak and Foster, 1982. pp. 532-533.

Story, Keith O., <u>Approaches to Pest Management in Museums</u>, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 49-50.

Common Name: **Drugstore Beetle**

Scientific Name: Stegobium paniceum (L.)

Description: Adults are cylindrical in shape, approximately 2.5 mm (1/10") long, and light brown with silky hairs. The elytra or wing covers are striated. Their antennae are clubbed. The larvae are similar in appearance to the cigarette beetle, being white with a brown head capsule, but are much less hairy.

Damaging Stage(s): The larva is the most destructive stage, but the adult will also feed.

Materials Damaged: Books; spices; grains; flour; seeds; baskets; wooden objects and building supports. Has been found feeding on mummies, also on wool, and has damaged aluminum foil and tin.

Ecology/Habits: Undergoes complete metamorphosis. Life cycle takes approximately 7 months. The adult female lays her eggs singly in foodstuffs. The eggs hatch between 12 and 37 days. The larval stage can be as long as 5 months depending upon temperature and relative humidity. Like the cigarette beetle, the drugstore beetle can make a chamber of the food material for a quiet place in which to pupate. Pupation lasts 12-18 days depending upon temperature and relative humidity. Up to four generations can be produced in a year, but one per year is normal. In infested materials, the adults often escape detection because their legs and antennae are held close to the body when the insect is at rest.

References:

NPS Integrated Pest Management Information Package XVI.

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 529-530.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. p. 45.

Common Name: **Black Carpet Beetle**

Scientific Names: Attagenus unicolor Brahm; Attagenus megatoma (F.); Attagenus piceus (Olivier)

Description: The adults are black or dark brown oval beetles, 2.8-5 mm in length. The larvae are long, up to 8-10 mm in length, carrot-shaped and golden brown in color with long silky hairs at the posterior. The body of the larva is covered with short stiff hairs. The egg is tiny and pearly white in color.

Damaging Stage(s): Larva.

Materials Damaged: Wool, silk, fur, felt, feathers; also, insect specimens; leather; casein; hide glue; books; bird and mammal specimens. Will feed on some plant materials such as yeast and some cereals, seeds and grains.

Ecology/Habits: Undergoes complete metamorphosis. Life cycle length varies from 6 months to a year, with most of the life cycle spent in the larval stage. Life cycle length is very temperature dependent. Adults are initially attracted to light and feed on the pollen of flowers. After feeding, the adult female looks for a secluded food source such as the lint in cracks and crevices in which to lay her 60-90 eggs. The eggs are very fragile and are easily damaged by brushing or vacuuming. Eggs hatch in 5-16 days. Larvae go through 5-11 instars. If food is scarce, they will cannibalize one another and will feed on their own cast larval skins. They can survive for a considerable amount of time without food.

References:

NPS Integrated Pest Management Information Package XXXIII.

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 397-400.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. p. 31.

The Protein Feeders

Common Names: **Common Carpet Beetle; Buffalo Bug; Buffalo Carpet Beetle; Buffalo Moth.**

Scientific Name: Anthrenus scrophulariae (L.)

Description: Adults are oval and approximately 3 mm in length. Their elytra are blackish with white scales which gives them a speckled appearance. A major characteristic is the longitudinal stripe of orange and red scales down the middle of the elytra. The body is covered with orange and white scales. The larvae are 2.5-5 mm in length and are red to brown in color with black or brown hairs. There are a few long hairs on the posterior end. The eggs are small and white and have a small projection on one end which helps to anchor them to a food source such as textiles.

Damaging Stage(s): Larva.

Materials Damaged: Wool, silk, fur, hair, feathers, insect specimens, piano felts, carpets, quill, baleen, hide glue, and bird and mammal specimens. Also has been found in herbarium specimens and some cellulosic fibres such as jute, linen and cotton, especially if soiled.

Ecology/Habits: Undergoes complete metamorphosis. Average life cycle is 4 months. Depending upon the environmental conditions, the eggs will hatch between 10 and 18 days. The larvae undergo six instars with an average span of the larval stage of 66 days. Pupation occurs in the last larval skin and the pupae lie quiet for about 2 weeks. Adults feed on the nectar and pollen of flowers, and researchers hypothesize that the adult female requires this food in order to lay her eggs. White and cream-colored flowers are the most attractive to the adults.

References:

NPS Integrated Pest Management Information Package XXXIII.

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 400-402.

Common Names: **Varied Carpet Beetle; Buffalo Carpet Beetle**

Scientific Name: Anthrenus verbasci (L.)

Description: The adult is 2-3 mm long. The elytra are covered with a varied pattern of white, brown and yellow scales. The underside of the body is covered with long, greyish scales. The larvae are up to 5 mm in length, narrow at the head and broader at the rear; the body appears to have rows of alternating light and brown transverse stripes. There are three dense tufts of bristles and hair on either side of the rear of the body which become erect when the larva is disturbed. The eggs are rough surfaced and approximately 0.27 mm in diameter.

Damaging Stage(s): Larva.

Materials Damaged: Wool, silk, fur, feathers, mammal and bird specimens, whalebone, horn, hide, insect specimens. Also have been found in grains and spices.

Ecology/Habits: Undergoes complete metamorphosis. The average life cycle is about 1 year, although it can be lengthened by lack of adequate food. The adult female will lay about 40 eggs on both food and non-food sources. The eggs hatch in about 18 days depending upon the temperature and relative humidity. The larvae average 7-8 instars, with as many as 16, depending upon environmental conditions. Pupation occurs in the last larval skin and will last 10-13 days at room temperature. After pupation, the adult beetle will experience diapause, or a resting phase, for a few days prior to emerging from the pupal skin. The adults feed on the pollen of white flowers and are usually attracted to light.

The adults can fly fairly high and can enter buildings through open, unscreened windows. Larvae and adults have been found outdoors scavenging in bird and wasp nests.

References:

NPS Integrated Pest Management Information Package XXXIII.

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 405-408.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. p. 25.

Common Name: **Furniture Carpet Beetle**

Scientific Names: Anthrenus flavipes (LeC.); Anthrenus vorax (Waterh.)

Description: Adults are blackish in color but have yellow and white scales. The adults range in size from 2.0-3.5 mm in length and are oval in shape. The larva is similar in appearance to that of the varied carpet beetle and when mature is reddish-brown in color, although as it ages it changes color from white to light yellow and tan to red.

Damaging Stage: Larva.

Materials Damaged: Animal products of all kinds, particularly hair, upholstered furniture, wool, feathers, silk, horn, tortoise shell, bird and mammal specimens, and products of vegetable origin that have been stained with perspiration, blood or urine.

Ecology/Habits: Undergoes complete metamorphosis. The average life cycle lasts 6 months to a year. Found primarily indoors; outdoors the adult is the overwintering stage. The female beetle lays three batches of eggs, ranging from 1-57 eggs per batch. Eggs are laid on a food material. Depending upon the environmental conditions, the eggs will hatch in 9-12 days. Like other pest dermestids, the majority of this beetle's life is spent in the larval stage, where it molts from 6-12 times over 70-300 days. Pupation occurs in the last larval skin and takes about 2 1/2 weeks. The newly formed adult will rest in the pupal skin for 6-71 days and is then active for about 60 days. Adults feed on pollen.

References:

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 402-405.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 25-26.

The Protein Feeders

Common Name: **Hide Beetle**

Scientific Names: Dermestes maculatus (DeG.); Dermestes vulpinus (F.)

Description: Adults are reddish-brown to black and about 5-10 mm in length with dark elytra which taper at the ends to a fine point. The larvae are very hairy. Eggs are creamy-white in color and approximately 2 mm long.

Damaging Stages: Larva and Adults.

Materials Damaged: Feed on leather, hide, bird and mammal skins. Pupation is done in quiet places, usually in hard materials and the literature reports that wood, cork, books, and woolens have been damaged by the boring larvae.

Ecology/Habits: Undergoes complete metamorphosis. The life cycle is between 60 and 90 days depending upon the temperature. The female lays her eggs in cracks in skins and hides. The eggs hatch in 2-12 days. The larvae molt seven times on the average, with the larval stage ranging from 35-230 days. At higher relative humidities, development is accelerated and the numbers of molts decreases. The larvae are voracious feeders, shun light and are very mobile. When seeking a protected pupation site, they can wander as far as 30 feet. Pupation occurs in dense materials and lasts about 7 days. During the first 5 days of adulthood and during egg laying, the adults are photophobic. After egg-laying, the adults are no longer photophobic. Adults are strong flyers. These beetles can enter buildings on flowers and can fly in through open doors and unscreened windows. The adults also feed on flowers and shrubs.

References:

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 392-395.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. p. 21.

The Protein Feeders

Common Name: **Larder Beetle**

Scientific Name: Dermestes lardarius (L.)

Description: Adults are 5-8 mm in length, brown to black in color with a lighter transverse band across the elytra. The antennae of the adults are clubbed. Larvae are hairy, 11-13 mm in length and have alternating bands of light and dark brown. On the larva, there is a curved spine on the second to the last body segment.

Damaging stages: Larva and adult

Materials Damaged: Feed on hides, horn, fur, feathers, bird and mammal specimens, insect specimens. When pupating, the larvae burrow into dense materials such as books, wood, and cork.

Ecology/Habits: Undergoes complete metamorphosis. Life cycle ranges from 5 months to a year and a half. The adult female lays 102-170 eggs. The eggs are laid in cracks and crevices of a food source and will hatch in 2-12 days depending upon the temperature. The larvae are nocturnal, shun light and are voracious feeders. Larvae molt five to six times. After the final molt the larva wanders quite actively in search of a suitable location in which to pupate. Pupation lasts from 3-10 days. The optimum temperature range for development is 65-68°F.

Reference:

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 390-392.

The Protein Feeders

Common Name: **Webbing Clothes Moth**

Scientific Name: *Tineola bisselliella* (Hummel)

Description: Adults are covered in golden yellow scales and are distinguished by a tuft of fine bronze-colored hairs on the head. The wings are fringed. Their wingspan is approximately 12-14 mm. Adult females are larger than adult males. The larvae are shiny, creamy-white and about 8 mm in length. Eggs are 1 mm long, with a ridged surface, oval and white, and are difficult to see without magnification.

Damaging Stage: Larva

Materials Damaged: Hair, wool, fur, feathers, upholstered furnishings, piano felts, insect specimens, soiled materials of vegetable origin.

Ecology/Habits: Undergoes complete metamorphosis. Adults and larvae are photophobic and can be found in dark undisturbed locations. Adults can fly, but gravid females prefer walking to flying. The life cycle ranges from 3 months to 4 years depending upon temperature and available food. Development is slowest when the relative humidity is less than 75%. The adult female lays her eggs on food materials in undisturbed locations. An average of 40-50 eggs are laid and are attached to the food source with a gelatinous glandular secretion. The eggs hatch in 4-10 days. The larvae leave strands of sticky, silken webbing on the surface of infested materials. They also produce silken feeding tubes. The larvae are very active and feed both inside and outside of the feeding tubes. Unlike the casemaking clothes moth, the webbing clothes moth larva does not move its feeding tube and it can survive outside of it. When ready to pupate, the larvae spin pupal cocoons which often incorporate bits of the material upon which they are feeding. The pupal cocoon is about 5 mm in length. Pupation takes from 8-21 days depending upon environmental factors. The pupal skin is left protruding from the cocoon when the adult emerges. Adults tend to remain in close proximity to the materials upon which they pupated. Visual evidence of a webbing clothes moth adult usually indicates a major infestation. Damage ranges from surface feeding to holes completely through a material. Produces round fecal material in the color of the material upon which the larvae are feeding.

References:

NPS Integrated Pest Management Information Package XXXIII.

Mallis, Arnold, *Handbook of Pest Control*, Franzak and Foster, 1982. pp. 357-364.

Story, Keith O., *Approaches to Pest Management in Museums*, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 33-35.

Common Name: **Casemaking Clothes Moth**

Scientific Name: *Tinea pellionella* L.

Description: The adult is brownish in color with three darker spots on the wings which become more indistinct as the adult ages. The wings are fringed. The wingspread is about 10-14 mm. The larvae are white with brown heads and spend their life in a feeding tube spun from silk and bits of the material upon which the larva is feeding. The case is usually between 6 and 9 mm in length.

Damaging Stage: Larva

Materials Damaged: Feathers, feather and down-filled materials; wool; fur; piano felts; and has been reported in basketry, tobacco, seeds, and spices.

Ecology/Habits: Undergoes complete metamorphosis. Life cycle is very similar to the webbing clothes moth. The larva will die if separated from the feeding tube. The tube will often be the same color as the food source. The amount of damage depends upon the amount of time spent in one spot. This moth is more prevalent in the southern United States where two generations may occur in one year. Pupation occurs in dark, undisturbed locations. The adults shun light.

References:

Mallis, Arnold, *Handbook of Pest Control*, Franzak and Foster, 1982. pp. 364-366.

Story, Keith O., *Approaches to Pest Management in Museums*, Conservation Analytical Laboratory, Smithsonian Institution, 1985. p. 33-35.

The Starch Feeders

Common Name: **Silverfish**

Scientific Name: *Lepisma saccharina* L.

Description: Approximately 12 mm in length, silver grey in color; soft-bodied; nymphs and adults are similar in appearance.

Damaging Stage: Nymphs and adults.

Materials Damaged: Textiles, books, manuscripts.

Ecology/Habits: Undergoes incomplete metamorphosis (egg, nymph and adult); feeds on starches and sugars of materials derived primarily from plants. Eggs are laid in crevices and under objects, and depending upon environmental conditions they hatch between 20 and 40 days. Life cycle ranges from between a few months to 2 or 3 years. Prefer warm, damp areas with temperatures above 75°F and relative humidities between 80 and 95%. They avoid light.

References:

NPS Integrated Pest Management Information Package XXIX.

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 84-85.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 17-19.

The Starch Feeders

Common Name: **Firebrat**

Scientific Name: *Thermobia domestica* (Pack.)

Description: Similar in appearance to silverfish except slightly longer (14 mm) and mottled brown or tan.

Damaging Stages: Nymph and Adult

Materials Damaged: See silverfish.

Ecology/Habits: Firebrats, like silverfish, undergo incomplete metamorphosis. Females average 50 eggs, laid in crevices. Nymphs mature in 2 to 4 months and adults molt throughout their life. They prefer warmer temperatures to silverfish ranging between 90-105°F and 65-80% relative humdidities. Shun light.

References:

NPS Integrated Pest Management Information Package XXIX.

Mallis, Arnold, *Handbook of Pest Control*, Franzak and Foster, 1982. pp. 85-86.

Story, Keith O., *Approaches to Pest Management in Museums*, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 17-19.

Common Names: **American Cockroach; waterbug, Bombay canary, or flying waterbug.**

Scientific Name: Periplaneta americana (L.).

Description: Adults are reddish-brown to brown in color, sometimes with a yellow or sandy-colored band around the thorax. Nymphs can be grayish in color. Adults are 38-50 mm in length. The adults of both sexes have wings with the wings of the males extending over the abdomen by 4-8 mm, while the wings of the females extend about the same length as the abdomen. The nymphs resemble adults but do not have wings.

Damaging Stages: Nymph and Adult

Materials Damaged: Fecal deposits and glandular secretions can stain all types of materials. Omnivorous, feeding on all types of proteinaceous and cellulosic materials: leather, textiles, book bindings, papers with glues, paste of sizings, live and dead insects, hair, with a preference for sweet, decaying organic matter. They can form irregular holes and can superficially graze objects.

Ecology/Habits: Undergoes incomplete metamorphosis: egg, nymph and adult. The ootheca, or egg case is purse-shaped, longer than 1/3" in length, dark brown to black and contains two rows of eggs, with eight eggs on each side. It is deposited on the day it is formed, usually in a dark, damp, warm place near a food source. Females will deposit between 15 and 90 egg cases at the rate of 1 case per week. The ootheca takes approximately 55 days to hatch. The nymphs will molt 9-13 times and depending on food, moisture and temperature they will take 1-2 years to mature. Adults will live from 3 months to 2 years. Nocturnal, although visible if habitat is disturbed. The adults sometimes will fly and will glide for long distances. The American Cockroach's natural habitat is outdoors, but they are sometimes found in large quantities inside walls. They prefer warm, dark and moist areas such as steam tunnels and areas around water and sewer lines.

References:

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 114-117.

Truman, Lee C., Gary W. Bennett, and William L. Butts, Scientific Guide to Pest Control Operations, Harcourt Brace Janovich, Inc., 1982, p. 96.

Common Names: **German Cockroach; "croton bug"**

Scientific Name: Blatella germanica (L.).

Description: Adults are light brown and about 13-16 mm long. They have two longitudinal dark stripes on the pronotum. Nymphs resemble adults, having the same dark stripes on the pronotum, but they do not have wings. They are also usually darker in color with a single light stripe running down the middle of the back.

Damaging Stages: Nymph and adult

Materials Damaged: German roaches will feed on almost anything. Glandular secretions and fecal matter will cause staining.

Ecology/Habits: Undergo incomplete metamorphosis. The female carries the ootheca until it is about to hatch. The ootheca is slender, tan and about 1/3" long containing 12-24 eggs on each side. The German Cockroach has the highest reproductive level of all of the common cockroach species that infest structures in North America. They are nocturnal, usually becoming active within the first 2 hours after dark. They prefer environments where there is pressure on their backs and their abdomens and therefore will survive comfortably in dark cracks and crevices. They will survive for quite a long time without food but require water. NPS Integrated Pest Management Information Package V is quite specific and detailed about the ecology and habits of this pest.

References:

NPS Integrated Pest Management Information Package V.

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 110-114.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 7-9.

Truman, Lee C., Gary W. Bennett, and William L. Butts, Scientific Guide to Pest Control Operations, Harcourt Brace Janovich, Inc., 1982, p. 93-96.

Common Name: **Brownbanded Cockroach**

Scientific Name: Supella longipalpa (Serville)

Description: One of the smallest roaches. Less than 12.5 mm in length. Light brown in color, the adults are identified by two lighter bands running across the abdomen and the wing bases. These bands are more readily seen in the nymphs and the adult females. The ootheca is purse-shaped and light brown.

Damaging Stages: Nymph and adult

Materials Damaged: Prefer starchy materials. Have eaten the adhesive off of philatelic collections and envelope flaps. Will eat textiles.

Ecology/Habits: Undergoes incomplete metamorphosis. The brown-banded roach requires less moisture than the german roach, therefore will be found throughout a structure, not just where there is an available moisture source. Nocturnal and dislikes light. Will be found in picture frames, light switches, electrical equipment, picture moldings, cracks and crevices near ceilings, inside furniture. Usually likes warmer areas. The female roach will carry the ootheca for a few days and then will attach it to a protected area on a food source. Brownbanded oothecae have been found in picture frames, the folds of upholstered furniture, and inaccessable joints in furniture. The egg capsules generally contain about 18 eggs and hatch within 50 to 75 days, depending upon the ambient temperatures. Nymphs will mature in 180 days; adults will live about 10 months.

References:

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 120-122.

Truman, Lee C., Gary W. Bennett, and William L. Butts, Scientific Guide to Pest Control Operations, Harcourt Brace Javovich, Inc., 1982. p. 97.

Common Names: **Oriental Cockroach; "Waterbug;" "Black Beetle;" "Shad Roach"**

Scientific Name: Blatta orientalis (L.)

Description: Adult females are 34 mm long; males about 26 mm. The females have rudimentary functionless wings, whereas the male wings cover about 3/4 of the abdomen. Neither fly. Dark brown to black in color. Adults and nymphs are very sluggish.

Damaging Stages: Adult and nymph

Materials Damaged: More of a nuisance pest in the museum than other cockroaches. They will feed on any decaying organic material.

Ecology/Habits: Undergoes incomplete metamorphosis. Usually found at ground level or below ground level in high moisture areas, but it will ascend water pipes to be found on upper levels of structures. Aggregate in great numbers when the environmental conditions are right. The female will carry the ootheca up to 5 days and will deposit it in a warm, protected place with food nearby. The ootheca contains 16 eggs. The average incubation period for this ootheca is 60 hours. Usually the nymphs undergo seven molts. Life span is from 1 to 4 years.

References:

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 118-120.

Truman, Lee C., Gary W. Bennett, and William L. Butts, Scientific Guide to Pest Control Operations, Harcourt Brace Janovich, Inc., 1982, p. 96-97.

Common Name: **House Cricket**

Scientific Name: Acheta domesticus (L.)

Description: Adults are 18-22 mm long with long thin antennae. Their bodies are yellowish brown and have three dark bands on the head. The nymphs are similar but without developed wings.

Damaging Stages: Nymph and Adult

Materials Damaged: Textiles: especially silk and wool, also linen and rayon; fur; leather; fruit; vegetables; paper - particularly if soiled; rubber, meat, meat products and dead insects. Holes made by crickets are large.

Ecology/Habits: Crickets enter buildings from the outside when the weather turns colder. Females will deposit eggs singly in dark cracks and crevices, with the number of eggs deposited dependent on the temperature. Growth and development are accelerated by warmer temperatures and they will seek shelter in warm areas near stoves, fireplaces and furnaces. Crickets are nocturnal and are attracted to lights and warmth. They require moisture sources.

References:

NPS Integrated Pest Management Information Package VI.

Mallis, Arnold, Handbook of Pest Control, Franzak and Foster, 1982. pp. 158-160.

Story, Keith O., Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution, 1985. pp. 11.

Truman, Lee C., Gary W. Bennett, and William L. Butts, Scientific Guide to Pest Control Operations, Harcourt Brace Janovich, Inc., 1982, p. 171.

3. <u>Vertebrates</u>

Rodents and birds can cause both direct and indirect damage to museum collections.

Rats and Mice

Rats and mice cause damage through chewing, nesting, excreting, and smearing of collection objects with dirt and grease. Refer to NPS Integrated Pest Management Information Packages XXII "House Mouse" and XXVII "Rats" for information on their life cycles and habits.

The presence of mice and other rodents in a museum structure should serve as a warning that insects damaging the collections may also be present. Rodent nests are often habitats for carpet beetles, and other insects that feed on fur and animal excreta found in the nests. These insects can easily migrate from the rodent nests to collection materials.

The traditional use of poison baits for rodent control can also cause secondary problems. Although the poison bait will kill the rodent, it will not kill insects (certain carpet beetles, cellulose feeders) that may feed on it. Furthermore, when a rodent has consumed enough poison bait to kill it, it may die in an inaccessible location, becoming food for insects which will feed on the carcass and then migrate to museum collection materials.

Birds

Birds can cause damage to museum objects through their droppings which can stain objects, and, in the presence of moisture become acidic. These acids can degrade acid-sensitive materials. Like rodents, their nests are habitats for carpet beetles and other insects that feed on their droppings and cast feathers. These insects can migrate from the bird nests to museum collection objects.

Refer to NPS Integrated Pest Management Information Package XXIV, "Pest Birds: Pigeons, Starlings, House Sparrows" for information on the ecology and biology of pest birds.

Bats

Bats rarely have caused direct damage to museum collections and they are basically considered beneficial animals because they eat mosquitoes and other insects. However, like rodents and birds, their roosts and droppings can provide food for insects which can damage museum collections. Bats and bat control are discussed in NPS Integrated Pest Management Information Package III, "Bats in Structures."

There also is a potential exposure from diseases transmitted from avarian and bat droppings. For information on this issue, refer to the WASO Safety Management Release No. 83-4.

C. ESTABLISHING A MUSEUM INTEGRATED PEST MANAGEMENT PROGRAM

1. Preventive Program

The damage caused to museum objects by pests is almost always irreversible. Once an object becomes infested, the options for eliminating the infestation without further damaging or altering the object are limited. Many of the chemicals traditionally used to manage infestations have been found to damage or somehow alter the material from which the object has been made. This is contrary to one of the basic tenets of museum conservation--a treatment must be reversible and not alter the materials of the object or specimen. Therefore, **it is preferable to prevent pests from gaining access to or becoming established in the collections.** This can be accomplished by developing an IPM program for the museum. Through an effective IPM program, those elements essential to pest survival (e.g., food, moisture and habitat) are minimized.

The basic components of any IPM program are monitoring and identification, inspection, habitat modification, good housekeeping, treatment action, evaluation, and education. These components are on-going and cyclical in nature. For a park's museum IPM program, these components are used in five activities:

- Determination of Biological Activity
- Prevention of Pests from Gaining Access to and Surviving in Museum Spaces
- Establishment of Thresholds for Pest Activity
- Treatment Actions to Modify Conditions that Permit Pest Access and Survival
- Action to Take When an Infestation is Discovered

a. Determination of Biological Activity

Monitoring is the key to developing an effective IPM Program. Monitoring provides baseline information on the biological activity and climatic conditions in the museum collections: where the pests are, how they came into the museum, and why they are surviving. It can also help to determine strategies to take to eliminate future access and survival of pests in the collections. Finally, monitoring can help evaluate the effectiveness of any treatment action taken.

For museum IPM there are two types of monitoring: monitoring for pests in the collections and environmental monitoring. Environmental monitoring, discussed in Chapter 4, not only provides information critical to the protection of collections against climatic damage, but also provides information about the

interior climatic conditions of the building which might help to support an infestation.

Monitoring for pests is accomplished through the documentation of biological populations within the museum. Monitoring relies on the use of a variety of techniques such as direct observation, population sampling, routine inspections and passive trapping. Depending upon the target pest, different techniques are used.

Since most insect pests of collections are small, shun people and are nocturnal, one of the easiest ways to document their populations in museums is to use traps placed throughout the area to be monitored. Traps are passive and will record the presence of pest populations when humans are not present. Traps are also useful because they can document the distribution of the insect population over time.

The most effective all-purpose insect trap currently available is a "sticky" trap commonly known as a "roach motel." These come from a variety of manufacturers and usually in two shapes a box and a tent. Both shapes consist of cardboard with an adhesive layer tacky enough to catch insects. For a wide variety of insects, the tent-shaped trap may be best. These traps contain a food bait attractant. Information about sticky traps is included in the NPS Tools of the Trade.

Steps for Establishing an Insect Trapping Program

1) Draw a floor plan of the area to be monitored. On the floor plan, indicate the location of all doors, windows, water and heat sources as well as floor drains. Furniture should also be illustrated. In addition, if the area being monitored is a collection storage or exhibition area, cabinets and cases should be marked on the floor plan with notations made as to the type of collection material that is stored or exhibited.

2) Number and date the traps.

3) Place traps throughout the area to be monitored: critical areas are around the perimeter walls; in corners; near doors; under furniture; near water sources; near heat sources; inside and outside exhibit and storage cabinets.

4) Indicate the location of the traps on the floor plan.

5) Inspect the traps on a regular schedule and record in a logbook or on a form the following information: the trap number; the location of the trap; the date inspected; the species of insects and number of individuals per species found in the trap. Also useful is a notation of the life stage of the species found, unusual conditions (e.g., leaky pipe, maintenance work), and replacement date for a trap. Park staffs may devise their own survey form. Refer to Figure 5:1

for a sample Museum Integrated Pest Management Survey Form. During the initial phase of the monitoring period -- usually the first 3 to 6 months -- inspect the traps weekly.

6) As the trapping routine becomes more regular, refinements in trap placement and inspection periods can be made depending upon the structure and the evidence found in the traps. An understanding of the biology of the pest will assist in the placement and scheduling for the maintenance of the traps. It is important, however, not to leave the traps uninspected for too long a time because the dead insects caught in the trap can become attractive as food sources for other insects and rodents, which may feed on the dead insects in the trap without getting caught.

7) Traps should be replaced at least every 2 months, or when they become full, or when the adhesive loses its tackiness, whichever comes first.

Routine Inspections

Another important activity in monitoring for insects is making routine, thorough inspections for insect evidence of all the interior spaces of the structure, including the collections themselves. Gain a familiarity with the structure(s) housing museum collections. At least once a week the following areas should be checked for insects:

<u>Window Sills</u>: Sills are a common repository for insects which are attracted to light. This is especially important for determining if a carpet beetle problem exists since after pupation, the adults are attracted to light and attempt to go outside to feed on pollen and breed.

<u>Door Jambs</u>: Look for evidence of spider webs. If there are gaps around the doors, insects are likely to enter the building through these gaps. Spiders are likely to spin their webs so they can trap any insects entering the building through the gaps.

MUSEUM INTEGRATED PEST MANAGEMENT SURVEY FORM

Park:________________________________ Inclusive Dates:______________

Structure Housing Museum
Collection:_______________________________________
Exhibit Space____ Storage Space____

Name and Title of Inspector:____

Trap Number	Location of Trap - Brief Description	Total Insects Count/Week** Week #1	Week #2	Week #3	Week #4

**Note: If there are no insects in a trap, place "0" in appropriate box.

<u>Total Insects Collected</u>:

	Total Number of Insects	Trap Containing Highest Count of Insects
Week #1		
Week #2		
Week #3		
Week #4		

<u>Number and Identity of Each Species of Insect (Indicate trap number in which insects were found)</u>:

Circle in red any insect species that is a threat to museum collection. Indicate (use reverse side of form, if necessary), any unusual observances (e.g., rodent found in trap, puddle of water, flooding, unusual level of dust).

Figure 5.1. Example Museum Integrated Pest Management Survey Form

Inspect the museum collections at least every six months. Especially vulnerable materials, such as organic ethnographic materials and biological specimens, should be inspected more often. Look for cast larval skins of dermestid beetles, holes in textiles, piles of woodborer frass developing beneath wooden material, and frass and cut hairs off of animal skins in the bottoms of drawers and cabinets or cases.

All evidence should be thoroughly documented. Document what was found, where it was found and when it was found. If possible, identify the species of the insect. Without proper documentation, monitoring is not effective.

The identification of the insect and its life stage are critical to determining what is happening in the areas being monitored. To determine the species, refer to keys found in some of the references listed in this chapter's selected bibliography. Additional assistance with identifying insects can be obtained from the Park IPM Coordinator, the Regional Curator, the Regional IPM Coordinator, and NPS Cooperative Park Study Units. Assistance also may be obtained from entomologists through the cooperative Extension Service, U.S. Forest Service, State Departments of Food and Agriculture, and museums of natural history. Park curatorial staff may wish to establish an IPM pest reference collection to assist park staff in identifying pests. If such a collection is established, store it properly to protect it from biological deterioration.

Monitoring for rodents uses a combination of techniques, including the use of traps. Sticky traps known as glue boards are available for rats and mice. These are usually shallow plastic trays filled with an adhesive onto which the rodent walks and gets stuck. Also effective for rodents are old-fashioned snap traps which can be baited with cotton batting (an attractive nesting material, preferable for use in museums to a food bait, which can attract insects). Inspections using a variety of tools are also part of a rodent monitoring program. Refer to NPS Integrated Pest Management Information Packages XXII, XXVII and III for additional information.

<u>All park staff should be trained in "pest awareness</u>" and should immediately report any evidence of biological activity to the park's IPM coordinator. A logbook should be established, and any evidence of biological activity should be noted. Include location and description of the evidence, the material on which the evidence was found, the time of day, and the name of the finder. If actual insects are found, they should be collected and identified and this information should be included in the logbook together with the time of day that the insect was found and whether it was found alive or dead.

Once the monitoring programs have been established, regular analysis of the data collected can guide the park museum staff in developing strategies for minimizing or eliminating pests. If an infestation is found, the information gathered through monitoring provides critical

information concerning the extent and source of the infestation. The strategies can range from improving sanitation and dust control to building modifications made to correct failures in the seal of the building that aren't easily seen by humans, but permit insects or other pests to enter. For example, by placing a trap near an emergency exit door leading from the collection storage or exhibition space directly outside, the tightness of the seal around the door can be determined. If the door is opened only in emergencies, and the trap shows that over a month's time many insects of different species are being caught, the seal around the edges of the door should be checked to determine if it is tight. Once the repair to the seal of the door has been made, subsequent monitoring will indicate whether or not the repair was effective.

b. Prevention of Pests from Gaining Access to and Surviving in Museum Spaces

The structure as a physical barrier

All pests require three things for survival: food, water and shelter. The museum can provide all three. Therefore, restriction of pest access into the structure from the outside is very important. Adult mice require only a 1/4" opening to enter a building: rats a bit more; insects even less. Insects are attracted into a structure at night and on cloudy days by light. Rodents are attracted by warmth during cool weather, and dryness during damp weather. Some pests are attracted by the smell of food in the form of human food odors as well as the smell of certain collections (e.g., whale bones, have a strong odor, strong enough to attract red-legged ham beetles into a structure from outside).

Consequently, all structural gaps must be closed to prohibit access to the building. Effective materials and techniques include: weatherstripping around doors; caulking of joints around windows and doors; installing window screening on all operable windows; installing screening on floor drains.

Minimize harborage for insects and rodents outside the structure: the larger the population of insects and rodents directly around the structure, the greater the potential for pest entry. Install a 3-foot wide, 4 inch deep gravel strip around the perimeter of the structure to prohibit vegetation from growing around the foot of the structure. While this may not be acceptable for historic structures, which require appropriate landscaping, it is useful for non-historic buildings. The gravel strip will inhibit the growth of vegetation which provides harborage, nutrients and moisture for insects and rodents.

Similarly, if not prohibited by historic landscaping requirements, remove all ivy and other plants growing on the structure. They provide support for bird nests that become habitats for dermestids and other collection-feeding pests. Since branches can be used by

rats as access points to the roof of the structure, trees must be routinely trimmed to prevent them from touching the building.

Other regular maintenance activities which help to reduce biological activity around the structure include periodic cleaning and repair of gutters, grading the soil around the foundation so that water drains away from the building, and removal of bird and wasp nests. Many of these recommendations serve a dual purpose: to reduce pests from gaining access to the structure and prevent the structure from deterioration.

Establish a routine inspection program to maintain the exterior of the structure and surrounding vegetation.

Inspections should be documented and made at least once a month to note building changes, such as settling foundations, or evidence of biological activity around and on the structure.

Barriers within the structure

Inside the structure, good enclosure of the collections in storage cabinets and exhibit cases is the first defense against pests gaining access to the objects. Cabinets and cases must be well sealed. Gaskets are useful for improving the seal around doors and drawers. If holes are cut into cases for ventilation, these must be screened.

For exhibitions, enclose as much of the collection as possible. Limit the use of open displays. In historic furnished structures, enclosing exhibits may not be possible. Therefore, additional care must be taken to monitor all exposed objects in order to detect infestations before they become widespread.

Weatherstripping installed around interior doors will help to prevent pests from moving from one section of the building to another. This is especially important to separate public spaces (exhibit areas, information and sales areas, and office areas) from the museum collection storage areas.

All areas inside the structure must be routinely inspected for structural changes or failures.

Good housekeeping and sanitation

Most pests require only small amounts of food and water to survive. Consequently, dust found in cracks is often adequate to provide enough nourishment for survival. Rodents are nibblers and will feed on almost anything available, including dead insects. The dust in cracks and under furnishings is usually hygroscopic and will hold enough moisture to develop a microenvironment with high enough humidity to favor pest survival. Additionally, moisture from condensation on plumbing or water in sinks can provide enough moisture for an insect to survive.

Develop and implement a good housekeeping and interior maintenance program to minimize available food and moisture required for pest survival. Shelter for pests comes in many forms, including cracks and crevices in walls and floors, voids in walls, and clutter. To minimize shelter and areas in which nutrients such as dust build up, make the interior spaces of the building as seamless as possible: caulk all cracks and crevices with silicone caulk and close gaps around plumbing fixtures and pipe penetrations through walls, floors and ceilings.

Eliminate clutter. Clutter provides excellent hiding places for insects and rodents. It can also become food for some pests. Clutter gathers dust, which can be hygroscopic and can become a microenvironment supporting mold, mold-feeding insects and other insects. Dispose of all unnecessary materials and provide proper storage for equipment and supplies.

Minimize dust by building and cabinetry design and by proper sanitation. Cabinetry must be designed to permit easy access for cleaning the spaces beneath and behind.

Use vacuum cleaners to clean floors and structures. Dust mops collect dirt, dust, and insect eggs and larvae and can become a fertile breeding ground for insects, especially silverfish and cockroaches. All spaces must be vacuumed at least twice a week, more often in public areas and areas adjacent to the exterior of the building. A vacuum crack and crevice tool must be used at least once a week to remove dust and debris from cracks and joints. The vacuum cleaner bag and its contents must be disposed of properly outside of the building. Do not leave bags inside the museum because they can contain insect eggs.

After documentation, all evidence of rodents and insects must be removed and disposed of properly. Dead insects and rodent droppings can provide food for rodents and other insects.

Cultural controls

The collections can still become infested, despite good housekeeping, sanitation and tight barriers. The way this most often happens is through incorporating infested material directly into the collections. Uninfested materials can go on loan to another museum and become infested, new material can be accepted into the collections without knowing that it is infested, scholars and visitors can bring materials from "home" for comparison with the museum's holdings and an infestation can be established.

Establish an area outside of the collection storage and exhibition area for the inspection of new objects, or returned loans. Restrict the direct comparison of non-collection items against collection items. Do not incorporate any material into the collections until it has been judged to be pest-free.

Similarly, exhibit materials (e.g., props and new construction materials), equipment and supplies can be infested when brought into the museum. Set aside space near the museum's receiving area for thorough inspection of all material entering the building. If infested, do not bring this material into the building until it is pest-free. As plants and flowers can be nutrient sources for the adults of some carpet beetle species; they should not be brought into the museum.

Finally, restrict food and smoking in the museum. Pests can enter the museum in smoking materials and food bags. If food and smoking is permitted in the building, designate special areas far away from the collections that can be thoroughly cleaned. Dispose of food and smoking wastes properly. Do not leave them accessible to insects and rodents. Take wastes outside of the museum and dispose of them in tight-fitting receptacles.

c. Establishment of Thresholds for Pest Activity

Thresholds are the points at which some action must be taken to correct the evidence of a pest. In the museum, the threshold is site-specific in establishing the level at which action should be taken. The intensity of the action is determined by the proximity of the pest to the collection. For instance, a pest caught near the entrance door to a museum may not warrant extensive treatment, however its evidence should cause an increase in vigilence against pests in the collections space.

d. Treatment Actions to Modify Conditions That Permit Pest Access and Survival

As previously mentioned, monitoring programs provide information about biological activity within the museum space and the collections. Data from monitoring identifies what pests are in the museum, in what quantities, where they are located. It also may reveal how they came into the museum, and whether or not they can survive.

Monitoring helps to evaluate the building structure: Does it provide enough of a barrier against pests from the outside? Are there structural failures? What can be done to improve the seal? Monitoring also helps to evaluate a park's sanitation and housekeeping programs. From this information, improvements to the structure and modifications to the sanitation programs can be made. <u>Remember</u>: Taking preventive actions to exclude pests from museum spaces and exercising constant vigilance through monitoring and inspections are the keys to effectively controlling pest problems.

D. ACTION TO TAKE WHEN AN INFESTATION IS DISCOVERED

1. Three Action Steps

If an infestation is discovered in a museum storage or exhibit space, immediately initiate the below listed actions. These actions include steps to isolate and identify the infestation, develop a treatment strategy, and reviewing the effectiveness of the existing IPM Program.

Isolating and Identifying the Problem

a. Isolate the infested material. Heavy polyethylene plastic (6 mil minimum) is useful. Small objects can be placed in resealable bags (e.g., Ziplock® bags). For larger objects, a polyethylene tent can be made using tape or heat sealing equipment. Make sure that plastic is completely sealed.

b. Identify the pest.

c. Based on the habits of the pest, determine the extent of the infestation. Start at the site where the first infested object was found and inspect the collections/areas in ever widening circles. Isolate infested material as it is found and document the findings.

d. Determine the source of the problem. If the problem is structural, make structural repairs to the building. If infested material was brought into the collection, evaluate and modify the policies and procedures that permitted this to occur.

Treating the Problem

e. Develop a treatment strategy. A treatment strategy includes the following steps.

1) Identify the pest and the stage in its development that is found on the materials.

2) Identify the media of the infested material (e.g., what is the material composition of the object/specimen?).

3) Based on an understanding of the biology of the pest, its life stage when found, and the material of the object, answer the following questions:

- Can the infested material be disinfested through removing the pest?

- Are eggs present?

- What is the least damaging approach to treatment?

4) Treatment decisions must incorporate the identification of the pest, the infested materials, and the condition of the object. In consultation with the Park IPM Coordinator, the Regional Curator and a conservator, choose an effective treatment which will cause the least amount of damage to the object and to the environment. Treatment options range from simple cleaning to fumigation. If chemical options are selected, follow procedures outlined in NPS-77, Natural Resources Management Guideline. A summary of these procedures is outlined in Chapter 11, Section D of this handbook.

5) Document any and all treatments made. After treatment, the objects should be cleaned, with all the removable evidence of the infestation documented and removed, and any pest damage documented and added to the museum records. File all treatment/damage documentation in the appropriate Accession File or Catalog Folder, as outlined in the NPS Museum Handbook, Part II, Chapters 2 and 3.

6) Evaluate the treatment to determine if it was effective.

Reviewing IPM Program

f. Review the established museum IPM Program to determine how it can be modified to prevent a similar infestation from occurring in the future. Consult the park's IPM Coordinator and the Regional Curator.

g. As necessary, modify the park's museum IPM procedures. Document any modifications.

2. Fumigation

The word "fumigation" is commonly used to identify any chemical treatment of infested material. Although fumigants may exist in three physical states (e.g., solid, liquid, and gas), they must be converted to a gaseous or vapor state in order to effectively kill pests. Solid fumigants (e.g., paradichlorobenzene [PDB], napthalene, thymol) convert to a vapor state with heat and time. Liquid fumigants (e.g., dichlorvos [Vapona®], carbon disulfide) evaporate at room temperatures to a vapor state. Gaseous fumigants (e.g., ethylene oxide, methyl bromide, sulfuryl fluoride [Vikane®]) are distributed in pressurized cylinders for specific use in fumigation chambers. Refer to Appendix H, Section E for a list of the properties and hazards of some of the fumigants used in museums.

If it is determined that a chemical approach is necessary to control the pest infestation and is approved by the NPS IPM procedures, the park curatorial staff needs to keep in mind the following guidance:

a. The Environmental Protection Agency (EPA) is required by law to determine whether a pesticide can perform its intended function without causing "unreasonable adverse affects" on human health or

the environment while taking into account the potential benefits of the proposed use. Each product's label contains the EPA Registration Number. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1972 (as amended) prohibits, with limited exceptions, the use of any pesticide product for any purpose or in any manner not specified on the label. Refer to Section 2(e)(e) of FIFRA for these exceptions. For example, the fumigant ethylene oxide (EtO) is not approved for use on books and archival materials. In addition, EtO only may be used as a fumigant in a chamber, and not as a contact pesticide or deterrent.

b. FIFRA classifies all pesticide products as either "general" or "restricted" use. General use pesticides are those that will not cause unreasonable adverse effects to the user or the environment when used in accordance with the label. These products are available to the public with no restrictions except those that are specified on the label. Museum pesticides/fumigants in this category include paradichlorobenzene (PDB), napthalene, thymol, dichlorvos (e.g., Vapona®), and boric acid. Restricted use pesticides are those that cause adverse effects to the applicator or the environment unless applied by persons who have received specific training in their use. Methyl bromide, hydrogen cyanide, and sulfuryl fluoride (e.g., Vikane®) are museum fumigants included in this category. EPA's list of restricted use pesticides is updated monthly. Check with the park IPM Coordinator for a current list of the restricted use pesticides.

c. The law and NPS policy requires that a park staff person must be certified to handle and apply restricted use pesticides. NPS policy also requires that a park staff person must be either a certified pesticide applicator or be supervised by certified pesticide applicator in order to handle or apply any pesticide/fumigant in the park/center.

d. **The use of pesticides/fumigants (e.g., paradichlorobenzene, dichlorvos, napthalene, and boric acid) are only approved in response to controlling a specific infestation. These materials are not approved for use as preventive repellents or deterrents.**

e. Fumigation, a complex process, should be carried out by a trained and experienced person. The specific pest, the volume of space to be fumigated (e.g., chamber, room, structure), and the type(s) of museum material(s) involved determine the type and amount of fumigant to be used and the length of exposure. During application, the proper and effective use of a fumigant requires the strict control of environmental conditions (e.g., temperature and relative humidity).

For example, recent tests have confirmed that the proper and effective use of dichlorvos (Vapona®) requires strict control of environmental conditions and longer exposure times that had been known previously. In the past, dichlorvos has been used to

fumigate infested objects in a properly sealed museum specimen cabinet. The increase in exposure time to ensure maximum effectiveness of this fumigant increases the threat of damage to objects. The requirement for precise control during application and the need to properly protect staff during application time dictate that dichlorvos be used as a fumigant only in an approved fumigation chamber.

f. Fumigation chambers are expensive to build and operate. They require a certified operator. All fumigation chambers constructed and used in a park or center structure must be equipped with local exhaust ventilation. This exhaust system is designed to provide replacement air for the exhaust of the fumigant without having to open the chamber's door. Consult a ventilation engineer who has had prior experience with the proper design and specification for fumigation chamber exhaust and stacking systems. The Code of Federal Regulations, 29 CFR 1910.1047, provides the standards for the construction of a fumigation chamber to be used for the application of ethylene oxide. These standards should be followed for the use of any fumigant, especially fumigants on the restricted use list.

   Parks located in close proximity to a museum or other institution with a fumigation chamber should develop a working agreement with the institution to provide fumigation services when needed. However, ensure that the chamber is operated by certified persons. Portable fumigation equipment may be a practical approach to applying fumigants to infested objects in a park's museum collection. Although such equipment is expensive, it may be a cost effective alternative to constructing a fumigation chamber. Such a unit could be purchased by a regional office or collections center for loaning to parks that have infested objects. Contact the Regional Curator or the Curatorial Services Division, Harpers Ferry Office, for information on types of equipment that are available.

Remember: A chemical approach only is used when preventive measures are not enough to control an infestation. The fumigant applied brings the infestation under control and reduces the threat of damage to collections. Once the fumigation procedure is completed, the curatorial IPM program must be evaluated to determine how a future reoccurrence can be prevented. Objects that have been fumigated must be continually monitored to evaluate the success of this control method.

E. GLOSSARY

Complete Metamorphosis	Insect development that starts with an egg, progresses through a larval (or worm stage), goes through a pupal stage and finally emerges as an adult. Each life stage is distinct from the next.
Frass	Insect excreta and other by-products of insect activities.
Fumigant	A chemical which at a required temperature and pressure can exist in a gaseous state in sufficient concentration to be lethal to a given pest organism.
Gravid	Bearing eggs or young.
Habitat	Locale for a pest to survive.
Habitat Modification	Changes to the pests' habitat to inhibit survival.
Incomplete Metamorphosis	Insect development that starts with an egg, develops through a nymph that resembles an adult and then the adult.
Insecticide	A pesticide that kills insects.
Instar	Larval life stage between molts.
Integrated Pest Management	Defined in NPS-77, Natural Resources Management Guideline as: "The selection, integration, and implementation of pest management methods based on predicted economic, ecological and sociological consequences. IPM can also be defined as a decision-making process which helps one decide if a treatment is necessary and appropriate, where the treatment should be administered, when treatment should be applied, and what strategies should be integrated for immediate and long-term results.
Larva	The juvenile stage of an insect that goes through complete metamorphosis. Physically dissimilar from the adult--worm or grublike in appearance.
Nymph	Juvenile life stage of an insect that goes through incomplete metamorphosis. Physically similar to the adult.
Ootheca	Egg case or egg capsule (usually of cockroaches).
Pest	An organism that is at the wrong place at the wrong time and does damage.

Pesticide	A chemical used to kill a pest.
Rodenticide	A pesticide formulated to kill rodents.
Sticky Trap	A passive insect or rodent trap consisting of cardboard with an adhesive layer.

F. SELECTED BIBLIOGRAPHY

National Park Service, Integrated Pest Management Packages.

Dawson, John E.
1988 "The Effects of Insecticides on Museum Artifacts and Materials," A Guide to Museum Pest Control, pp. 135-150.

Flint, Mary Louise and van den Bosch, Robert
1977 A Source Book on Integrated Pest Management. University of California: International Center for Integrated and Biological Control.

Heim, Roger, Flieder, Francoise and Nicot, Jacqueline
1968 "Combatting the Moulds Which Develop on Cultural Property in Tropical Climates," The Conservation of Cultural Property, Chapter 3, pp. 42-44. New York: UNESCO.

Mallis, Arnold
1982 The Handbook of Pest Control. Cleveland, OH: Franzak and Foster Company.

Pinniger, David
1990 Insect Pests in Museums (Second Edition). London: Institute of Archeology Publications.

Okowski, William and Okowski, Helga
1983 Integrated Pest Management for Park Managers, A Training Manual. Napa, CA: John Muir Institute, Inc.

Story, Keith
1985 Approaches to Pest Management in Museums, Conservation Analytical Laboratory, Smithsonian Institution.

Truman, Lee C., Bennett, Gary W. & Butts, William L.
1982 Scientific Guide to Pest Control Operations, Harcourt Brace Janovich, Inc.

Williams, Stephen L. and Walsh, Elizabeth A.
1989 Curator. "Developing Chemical Pest Control Strategies for Museums: Effect of DDVP on a Museum Insect Pest," 32/1 (March), pp. 34-49. New York: American Museum of Natural History.

__________.
1989 Curator. "Behavior of DDVP in Storage Cases," 32/1 (March), pp. 41-49. New York: American Museum of Natural History.

Williams, Stephen L., Walsh, Elizabeth A., and Weber, Stephen G.
1989 Curator. "Effect of DDVP on Museum Materials," 32/1 (March), pp. 49-69. New York: American Museum of Natural History.

Zycherman, Lynda A. and Schrock, J. Richard (editors)
1988 <u>A Guide to Museum Pest Control</u>. Washington, D. C.: American Association of Systematics.

National Park Service, Vegetation and Wildlife Division. Washington, D. C.: Video Cassette Programs on Integrated Pest Management.

1985 "Integrated Pest Management" (15 minutes)

1987 "Structural Inspections - A way of Managing Wood Inhabiting Insects" (23 minutes)

1987 "Subterranean Termite Biology" (11 minutes)

1987 "Crack and Crevice Treatment for Cockroach Management" (13 minutes)

1987 "Pesticide Applicator Safety" (17 minutes)

CHAPTER 6. HANDLING, PACKING AND SHIPPING MUSEUM OBJECTS

Page

A. IMPORTANCE OF PROPER HANDLING

Physical handling is often overlooked as a source of potential damage to museum objects. Although it is largely a matter of common sense, proper handling is essential to object preservation. Careful handling of objects is a key element of a preventive conservation program.

Obvious examples of damage due to mishandling are the ceramic or glass object that is dropped and shattered into tiny pieces or a document that is torn. In other cases, damage may not be evident immediately. For example, metals can corrode from being handled without gloves, or a painting can later crack as a result of bumps and jarring that occurred during movement.

Handling objects as infrequently as possible is the best way to prevent such damage. However, day-to-day curatorial care often requires handling. Objects are usually moved and handled during such activities as cataloging, photographing, housekeeping, and packing for shipment.

Figure 6.1. Proper handling techniques are essential to museum housekeeping practices.

Damage resulting from mishandling museum objects is preventable. Proper handling of museum objects is largely a matter of developing an attitude of sensitivity to museum objects. It is the responsibility of the entire staff. The safety of each object can be ensured by observing the standard practices and rules for handling museum objects.

B. PRACTICES TO ENSURE OBJECT SAFETY

1. Establish Written Rules

The preparation of written rules on handling helps to foster a professional attitude and respect for the objects involved. Provide all staff with a set of written rules for handling museum objects. Post these rules in museum storage areas. Ensure that all staff and outside researchers involved with handling objects, read and follow the rules.

2. Train and Re-train

Do not handle museum objects without training. All training in handling museum objects should involve "hands on" experience in handling techniques. Re-training is a necessary reminder of the importance of proper handling. Frequent review of handling techniques should be required for both beginners and experienced personnel. Special training sessions are necessary when other staff members assist in handling objects.

3. Use Proper Supplies and Equipment

Ensure that equipment used in handling museum objects is of good quality and in good repair. The use of object support trays (e.g., specimen trays, baskets, boxes) avoids the unnecessary handling of objects.

Figure 6.2. The use of equipment and supplies such as carts and trays minimizes the need to handle objects.

Handling equipment may include flatbeds, carts, dollies, pallet lifters, and object support trays. It also includes the supplies used with the equipment, such as foam pads used to line carts and trays, furniture pads, acid-free tissue and cotton gloves.

Before moving an object, inspect equipment to ensure that it is safe for the objects and the handler. Adequate supplies should be on hand. If equipment or supplies are inadequate, postpone moving the object. Never take risks with museum objects.

Figure 6.3. Equipment and supplies for handling museum objects include trays, padding, tissue, gloves and carts.

4. Plan All Tasks Associated With Handling and Moving

Planning is essential before handling museum objects. The movement of museum objects, even for dusting or cleaning in an historic house museum, must never be considered routine. Thorough advance planning helps to keep the movement of objects at a minimum. Planning also reminds the handler that each museum object is special.

The planning process includes the following factors:

a. The object's structural characteristics and condition

Consider stresses that handling and moving will place on an object. An object may be extremely heavy, fragile or unstable and therefore will require specialized equipment or more than one person to move it.

Figure 6.4. An evaluation of this statue's structural characteristics resulted in the use of foam padding and a tray to increase protection before handling and moving the object.

b. The people required

Evaluate the experience of the people involved. Assign specific tasks to each person. Movers should know where the object is to go, the route to be taken, the equipment to be used, and the time needed to complete the move. If necessary, provide people with a set of written instructions.

c. <u>The object's new location</u>

Ensure that the location is prepared and ready to safely house the object.

d. <u>The route for moving an object</u>

Ensure that the route selected is clear. Within a structure, study spaces through which the object will pass (e.g., doorways, stairwells, display areas). Be aware of all surfaces with which an object may come into contact (e.g., floors, walls). If possible, avoid tight fits.

If the objects are to be transported outdoors, move them when weather conditions (e.g., rain, snow, extreme heat) pose minimum threats. If an object is transported some distance or to a location at a different elevation, be aware of weather conditions at the final destination in order to determine type of protective container.

e. <u>The personal health and safety of the handler</u>

Plans should address any health or safety hazards involved with handling objects, such as lifting heavy objects that might cause back or finger injuries; handling potentially dangerous objects such as historic firearms, ammunition, and medicines; and touching or inhaling fumes or particles from fumigated objects or natural history specimens treated with preservatives (e.g., arsenic). Refer to Chapter 12 for a detailed discussion of health and safety issues.

C. GENERAL RULES FOR HANDLING MUSEUM OBJECTS

- Handle museum objects as infrequently as possible. Plan storage areas so that one object can be moved without disturbing the others.
- Handle <u>every</u> museum object as though it is irreplaceable and the most valuable in the collection.
- Never smoke, eat, or drink while handling objects.
- Do not wear anything that might damage the object. To avoid scratching and snagging surfaces, be careful of breast pocket contents, jewelry, watches, belt buckles, name tags, and Service badges.
- Use only a pencil while working near objects to avoid applying a permanent damaging mark. Never use ballpoint, fountain, or felt tip pens near objects. Use measuring tapes and magnifying glasses with extra care to avoid touching the object and causing accidental damage.
- Keep hands clean even when wearing gloves. All materials and surfaces in contact with the object must also be clean.
- Wear clean white cotton gloves, except when handling objects like ceramics and glass that are too smooth to grip safely through gloves, or objects which have oily or tacky surfaces that can attract cotton fibers. Do not use white cotton gloves when handling plant, bird, mammal, insect, and wet specimens. Refer to Chapter 11 for discussion of protective gloves to be worn when handling natural history specimens and other objects suspected to contain pesticides. Surgical gloves or white cotton sure-grip gloves (e.g., PVC dots on palm and fingers) can be worn when handling objects with a smooth surface.

Figure 6.5. Use two hands and clean white gloves when handling museum objects.

- Save all information that is associated with an object (e.g., tags, labels).
- Know the condition of the object before moving it.
- Ask the following question: What is the strongest part of the object? Observe an object's center of gravity and lift it by supporting its

strongest structural component. Do not lift an object by protruding parts, such as handles or rims, because these areas are often the weakest.

- Handle only one object at a time, using both hands. Use one hand for support and use the other hand for balance. Objects of more than one component, such as a teapot and lid, should be handled separately to avoid abrasion. Stabilize loose parts that cannot be removed.

Figure 6.6. Pad moveable parts and separate objects of more than one piece to avoid damage during handling.

- When handling an object for cataloging or research, it may be necessary to place it in an unstable position. Exercise extreme caution in these situations. If distracted (e.g., by a telephone call) set the object down on a stable base or surface.

- Never hurry while handling objects. Handling requires total concentration on the object and the moving involved. Move slowly.

- Search all packing materials for additional pieces before discarding.

- If an object is damaged during handling, record the incident. Save all pieces. Report the accident to the appropriate personnel. Take photographs of the damage if possible.

In addition to the above general rules, there are specific rules for handling different types of objects (e.g., paintings, furniture, metals, paper, textiles, glass, ceramics, and stone). These specific rules are included in the appendix for each object type.

D. RULES FOR MOVING MUSEUM OBJECTS

- Lift objects. Do not push or drag them. Support objects from the base and side.

- Lift objects by their most stable surface. Do not handle objects by projecting parts, such as handles or rims. These areas are often the weakest. Use the most stable area of the object as its base.

Figure 6.7. A teapot should be handled by the base rather than the handle or spout.

- Do not overload carts or containers (e.g., chipboard trays, baskets, boxes). Make sure objects are padded, secured, and separated from other objects. Padding should be of acid-free materials.

- Do not allow objects to protrude beyond the sides of containers or moving equipment.

- Exercise caution if there is a need to walk backwards when moving objects.

- Plan the movement of objects so that each person knows what to do, equipment is safe for objects and people, and the route is clear. Limit the number of personnel responsible for moving objects.

- Make sure objects moved together on a carrier are of the same size, weight, and material. For example, do not move ceramics and heavy metal or wooden objects in the same container.

- Ask for help in moving large or heavy objects. Take no risks with museum objects or personal safety.

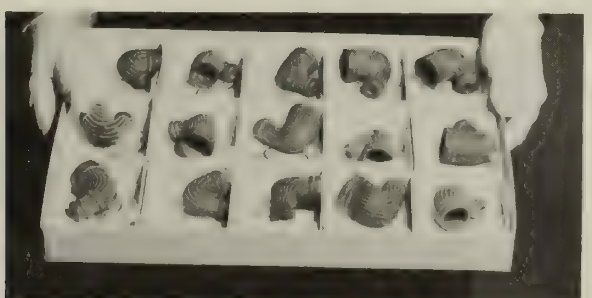


Figure 6.8. These pipe bowls were placed in individual specimen trays within a larger tray to prevent damage during movement.

• Use as few movements as possible. Take the container to the object rather than the object to the container.

E. IMPORTANCE OF PROPER PACKING AND SHIPPING

One of the most hazardous times for museum objects is during travel. Applying appropriate techniques and procedures for packing and shipping objects are essential elements of a preventive conservation program. The hazards of transit are numerous. Objects in transit may be subjected to rough jarring or dropping by movers, continual vibrations on an airplane, or exposure on a loading dock in the rain. Travel hazards include improper packing, shock, vibration, sudden changes in temperature and relative humidity, and mishandling, theft, vandalism and loss. For example, humidity fluctuations can weaken adhesives and cause soluble materials to migrate. Vibration may dislodge object attachments. Theft, vandalism and loss are other risks.

The goal of protective packing is to consider the worst possible hazards that an object may be subjected to during shipment and then to overcompensate thus minimizing those hazards. Ensure that objects are packed in such a way that the container and packing materials absorb shock and vibration, that the internal crate environment buffers against external temperature and relative humidity fluctuations and that packing materials used do not cause potential harm to the objects. Each object requires a unique packing solution. A properly packed container makes the crucial difference between whether an object arrives safely or damaged.

Remember: During any movement, an object is subjected to its greatest risk.

Moving and transporting an object from one location to another location involves the following three steps:

1. Preparation for Packing and Shipping Objects
2. Packing the Object
3. Shipping the Object

F. PREPARATION FOR PACKING AND SHIPPING OBJECTS

Packing and shipping museum objects require the following preparation:

1. Inspect and Document Condition of Each Object.

   Determine if the object can be safely shipped. Carefully examine each object considered for shipment to determine if its condition allows for safe travel. The structure or condition of some objects, like fragile glassware, wooden musical instruments, paintings on wood, pastel paintings, charcoal drawings or cracked porcelain, may preclude their safe travel. Consult the Regional Curator. Documenting the condition of objects identified for shipping may require a conservator.

   Before shipping, document the condition of all objects. This way, if damage occurs during travel the outgoing condition will be documented for insurance and other purposes. A portable light source and a magnifying lens can be used to identify signs of separation and lifted parts. Note areas of previous repair. Repaired areas might be weaker than original fabric and therefore more susceptible to damage. Repaired areas may also be stronger so that adjacent original material may be vulnerable to damage. With furniture, check to see that all attachments and joined sections are firm. Make sure paintings fit tightly in their frames, that the glazing is secure, and that there are no loose wires or hangers. Also check for tears at the canvas edges. Examine objects for signs of biological infestation.

   Photograph objects before they leave the park to provide a visual record in case the object is damaged or lost during shipment.

2. Determine Method for Shipment

   The method of shipment very often may be determined by the receiving party (e.g., conservator who is treating the object, or the museum borrowing an object). Also the value of an object may determine the method of shipment (e.g., a painting may need to be transported by a courier). The choice of shipment very often determines the type of external case needed. The fragility of an object and the transportation distance also are factors to consider.

3. Prepare a Workspace for Packing.

   Parks generally do not have a designated packing area so each park should select an area that can be cleared temporarily for packing. Select a space that is accessible to the museum storage area and that does not require moving objects up and down stairways and around tight corners or through narrow doorways. Equipment needed for packing includes a sturdy table with a padded surface, scissors, tape measures, and knives. Pad a table with a few sheets of 1/8" ethafoam covered with 4 mil polyethylene sheeting securely fastened beneath the work surface. Pad a work surface for textile objects with

unbleached muslin over polyfiber batting. Keep the table free of tools and other materials while packing.

4. <u>Acquire Packing Materials</u>.

   Refer to Section G.5. for types of packing materials.

5. <u>Observe all Rules for Handling Objects</u>.

   During packing, follow the rules for physically handling museum objects. Always wear the appropriate type of gloves when touching objects, and lift objects with both hands. <u>Remember</u>: the fewer times an artifact is handled, the greater chance it has for survival.

6. <u>Allow Sufficient Time to Pack Objects</u>.

   Good packing techniques can require hours and, in some instances, even days of time. It is important to schedule enough time to ensure that objects can be packed properly and without hurry.

G. PACKING THE OBJECT

1. The Exterior Container

Good quality and design of the container in which an object travels contribute to the object's chances for safe travel. The exterior container is always selected before packing because the choice of container is based on specific criteria.

Criteria for selecting a container depend on the physical characteristics of the item being shipped, the amount of space needed for the interior packing configuration appropriate to the object, the method of transportation, the distances and duration of the trip, environmental changes, and how often the object will be packed and unpacked. A good museum container is puncture proof, light-proof, water-tight, and protective against shock, vibration, and environmental changes. Materials used for shipping containers include metal, wood, cardboard, and polyethylene.

Light objects can be packed in double strength cardboard boxes. These are available to parks from local sources and GSA. For source information, contact the Curatorial Services Division through the Regional Curator.

Heavier objects (e.g., paintings, sculpture, furniture) or valuable and fragile items need the extra support of a wood or a polyethylene container. Museum packers have developed some standard techniques for shipping container fabrication. However, each container design must be specifically adapted to the individual object.

The following options are available for obtaining suitable packing containers.

a. Fabricate a container.

Building a wood container requires considerable carpentry skill and knowledge of packing techniques. Generally, nails and glue can be used to build it, but screws must be used on the lid once the object is inside. Never use nails because of the jarring vibration caused by hammering, the possibility of piercing an object, and the jarring caused by prying nails loose during the unpacking process. Line the interior with polyethylene or plastic sheeting and make padded braces to stabilize the object at its points of greatest weakness. Gaskets, handles, skids, and battons should be added for protection. Casters should be placed on large containers to facilitate movement.

When containers are shipped, they are often exposed to temperature variations, which can affect the object inside. Hygroscopic materials, such as wood, paper, natural fiber fabrics and silica gel can act as useful buffers against rapid relative humidity changes within the container. A tightly constructed wooden

container, screwed together with overlapping joints, is buffered by the interior, unpainted wooden surfaces.

b. Borrow a shipping container.

The Washington Office, Curatorial Services Division, lends shipping containers to parks for use in transporting museum objects. They are molded polyethylene with recessed hardware. A number of sizes and shapes are available. The larger ones have pressure release valves for protection on airplanes. To borrow a shipping container, submit a written request through the Regional Curator to the Curatorial Services Division, Attention: NPS Clearinghouse, WASO.

c. Purchase a reusable shipping container.

Parks that frequently pack and ship objects may want to invest in a reusable polyethylene container. Contact the Curatorial Services Division, WASO, for information on types and sources of reusable containers.

A packed shipping container should be neatly wrapped and labeled. Poorly constructed and shoddy looking wrapping invites rough treatment, whereas, a properly wrapped box will encourage care by handlers. Kraft paper is an excellent exterior wrap for cardboard boxes.

Shipping containers need clear identification markings. Put arrows on the sides to signify which end is up and letter neatly on the top face, "OPEN THIS SIDE." The package should be labeled "fragile." Do not mark package with phrases, such as "works of art" or "museum objects", which may attract thieves. Adhere all labels with tape to ensure that they remain affixed for the entire trip.

Centrally locate the typed or printed address. For added protection, place a duplicate label inside the package. Mark the total number of boxes on the address label, i.e., box 1 of 2, box 2 of 2. If the address is a P.O. Box, include the telephone number on the label. Always include the name of the recipient on the address label and call recipients in advance so they will be expecting the packages. Note: Print name and address of recipient in permanent marker ink directly on the carton. This procedure will ensure that if the wrapper is torn, the package will not have to be opened.

2. Positioning the Object Inside the Container

Evaluating the object's structure and planning for the worst possible travel scenario are critical in determining the object's orientation inside a packing container. Consider the object's weight and center of gravity and imagine which part of the object will receive the least breakage if the package is dropped. The heaviest part of the object should be placed low and as near to the center of the container as possible. Flat art works covered with glass should

always travel vertically. Detach and pack separately component parts of an object, such as a teapot and lid. Moving parts must be immobilized or removed and packed separately. Make a support for heavy portions of the object. Do not pack objects dissimilar in weight in the same container.

3. Covering and Wrapping the Objects

An initial covering is used to protect objects from abrasive packing materials and to serve as a moisture buffer. Use soft, unbuffered acid-free tissue paper for most objects. As much as possible, avoid tape when covering objects because the tape can adhere to the object. Instead, tuck the tissue in on itself or into an appendage. Be careful not to exert stress on the object by wedging tissue too tightly. Never crumple tissue in wads. Insert smooth pillows of tissue between objects.

The appropriate initial wrap for paintings is glassine paper or waterproof polyethylene paper (Tyvek®). Do not use plastic polyethylene sheeting as a preliminary covering because it traps moisture from condensation when temperature changes occur during shipment. This situation creates the risk of mold growth and other adverse reactions in the event of high levels of localized relative humidity. When shipping archeological metal in polyethylene bags, be sure to punch a hole in the bag before inserting the object to prevent condensation.

After covering the object, round off with tissue all projecting parts and handles. To illustrate this point, imagine a teapot. Soft, unbuffered acid-free tissue is placed around the spout, inside the teapot, and in the negative space of the handle. The end result is a rounded-off ball of tissue with projecting parts becoming an integral part of the whole. Wrap the entire teapot in one sheet of tissue or air-cap to hold the padding in place. Since this layer does not come in direct contact with the object, it can be taped to hold the package together. Label this exterior wrapping with object identification (e.g., object name and catalog number).

4. Cushioning the Object Inside the Container

Packing materials (e.g., air-cap, "potato chips," polyethylene foam blocks) "float" the object inside the container, absorb shock and vibration, and create a minimal thermal barrier. A general rule of thumb is to provide at least two inches of cushioning between objects in the same container and between the container walls. Allow 3-4 inches between very fragile items like ceramics and glass and between heavy fragile objects. Separate movable components of an object (e.g., separate a glass lamp's chimney from its metal base). Weight, fragility and sensitivity to environmental conditions (e.g., relative humidity and temperature) are criteria to consider in determining the number of objects to be packed in one container.

A variety of techniques can be used to cushion objects and provide shock absorption. Selection depends on the fragility, size, construction of an object, and on modes of transportation. These techniques include double-boxing, cavity packing and padding negative spaces.

a. Double-Boxing

Double-packing (packing an object in two sequential boxes) is an excellent cushioning procedure to use. To do this, immobilize the object and cushion it inside one box. Pack the first box inside a second box that is at least 2 inches larger on all sides. Completely fill the spaces between the boxes with newspaper or foam. Corner blocks or plastic shaped like doughnuts can be used instead of cushioning between the boxes. Corrugated fiberboard or wood can be used for either of the two containers.

b. Cavity Packing

Small to medium sized objects can be packed in successive layers of polyethylene foam sheets. This technique is clean, and easy to use in repacking. The diagram shows how the object shape is measured, marked on the foam with a pencil, and then the contour is cut out with a bread knife or electric carving knife. To protect against the abrasive polyethylene material, cover the cavity with soft, unbuffered acid-free tissue (Tyvek® or other smooth-surfaced inert material).

c. Padding Negative Spaces

A method to use for less fragile objects is to round off an object in tissue paper, then wrap it in successive layers of air-cap, place it inside the container, and pad the remaining spaces of the container.

Pieces of soft foam can be used to fill in the excess area. Traditionally, expanded polystyrene foam, often called "peanuts" have been used in the excess area. However, "peanuts" placed loose in the container create a situation that allows for the migration of an object. Loose "peanuts" obscure vision and add to the anxiety of the unpacking process. If "peanuts" are used, put them in small polyethylene bags and use the bags to cushion the wrapped object(s). Polystyrene foam in the form of "potato chips" is an excellent material for this purpose.

To make a cushioning brace, measure the distance between the object and the container and build polyethylene blocks and mounts to fill in the space. Open objects (e.g., pots, baskets) should be lightly filled with tissue to prevent collapse caused by the force of surrounding packing material pushing in on the object. Cover the closed-cell polyethylene with a less abrasive material (e.g., soft acid-free tissue) to protect the object.

Before closing container, place packing material above object to prevent movement if the container is overturned. However, the object must not support the weight of this material. Avoid too much compression so that padding material does not cause damage to fragile object. **Cushioning material should support and enclose but must not compress.**

Packing materials should be positioned firmly around all enclosed items so that no part of any item contacts the container walls and so the contents cannot shift position. Upon completion of packing, the container should be lightly jarred to determine if there is movement. If so, it must be repacked.

5. Packing Materials

Considering the nature of the object and its particular needs and the time it will be in transit is crucial when selecting packing materials. For instance, friable objects like ancient glass, slip-surfaced ceramics, and corroded metals are susceptible to mechanical damage caused by abrasive foams. Acidic tissue should not come in contact with acid sensitive works. Plastic bubble pack and foams may leave imprints on polished metals, varnished woods, oriental lacquer and other smooth-surfaced objects. To prevent such damage, curators should select appropriate materials for each packing situation. Never re-use packing materials.

a. Sources of Packing Materials

New packing products are continually being developed, so this list will need revision from time to time. Park staff should contact museum packers to learn of new materials. Some of the packing materials are available from the Curatorial Services Division, WASO. To obtain other supplies, parks can contact local museums for a list of packaging material suppliers or look in the telephone directory under "Boxes," "Packaging Containers," and "Packaging Materials." Materials used in museum packing are often the same as those used in shipping high-tech electronic equipment, so most areas should have a purchasing source. Some of these supplies are available through the General Services Administration. Check the Federal Supply Schedule under categories of "Cushioning Materials, Packaging and Packing Supplies."

b. Packing Materials

The following list identifies materials commonly used in packing objects for transit. The list is divided into materials used for specific functions.

Covering and Wrapping Materials (Materials that come in direct contact with the object must not stain, be abrasive, or be acidic.)

Glassine Paper - stiff, translucent, glossy texture. Use only for short-term storage (e.g., less than 30 days). Recommended for covering paintings, prints, photographs, bottles with labels, books or objects with a friable or oily/tacky surface. It will not adhere to dry varnish, waxed or other sensitive surfaces. Only use new glassine paper, because it deteriorates with age.

Tyvek® - slick, smooth, microporous, non-woven polyethylene sheet; an alternative material for glassine.

Tightly Woven Nylon - to put over cushioning foams to protect the object. Make sure material does not come in contact with the surface of delicate materials. Avoid using felt. Felt attracts pests. Knitted cotton (available in rolls) is a good, soft liner for ethafoam supports.

Soft, Unbuffered Acid-Free Tissue Paper - for covering basketry, metal and textiles. Do not use with protein materials like silk, wool, or leather or on photographs. Excellent for rounding off appendages and for filling in negative space. Buffered tissue paper should not be used with protein materials and photographs. Non-buffered acid-free tissue is preferable for contact with protein materials.

Unbleached Washed Muslin - for wrapping sculpture and textiles. Wash this material several times before using it to remove sizing and to make it softer.

Mylar - acid-free, clear, stable synthetic (polyester) film. Has an electrostatic charge. Good primary protector for paper. Never use on pastels or charcoal drawings.

Blanket Pads or quilts - for covering large sculpture and furniture.

Acid-Free Folders - to cover unframed prints, documents, and photographs.

Cushioning Materials (These materials are designed to absorb shock and moisture.)

A variety of foam products are available to use with the cushioning techniques described above. Each type of foam must be used correctly to achieve adequate shock and vibration protection. Each foam product offers different cushioning qualities, so a combination of foams may be used. New products are continually being developed.

Air-Cap - plastic with trapped air bubbles. Use with bubble side facing away from object's surface. Bubbles can leave impressions on an object's surface. Do not use with objects that can break bubbles. Several layers must be used to maximize the effect.

Susceptible areas like painting corners should receive extra layers. Always buffer the object with tissue or muslin to prevent cargo sweating.

Expanded Plastic "Peanuts" or "Potato Chips" - peanuts are messy, they settle and cling to surfaces. Dangerous to remove if they get caught in appendages. Retain moisture. Use only with small, light objects or in polyethylene bags. Instead of "peanuts," recommend using plastic "potato chips" with interlocking surfaces.

Polyethylene Foam Sheets - light, easily handled; creates a moisture barrier, and is shock absorbing and chemically inert. Sections can be joined with a heat gun, glue gun, or double faced tape. Available in various densities, thicknesses and textures. Use only white, avoid blue or pink colors. Expanded, closed-cell foam (Ethafoam 220): can be abrasive; use to support cushioned objects in container. (Volara®): thin sheets. Most useful for heavy objects.

Polyurethane Foam - available in gray or white. Good thermal insulator, excellent for cutting out object shape. Is not inert; it off-gases, absorbs moisture, and may be toxic if it catches on fire. Never store museum objects on a long-term basis in this foam.

Boxing Materials

Double-strength corrugated fiberboard boxes

Fome-Cor® - polystyrene foam sandwiched between two layers of clay-worked kraft liner board. Used as an inlay between prints

Tri-Wall Corrugated Fiberboard - use as base for objects and to design unique size boxes.

Marvel Seal - laminate of polyethylene (aluminum foil for impermeability and nylon for puncture resistancy); use as a box liner (maintains a microclimate).

Strapping Materials

Never allow tapes to come in contact with surfaces of museum objects.

Cellophane and Masking Tape - may be used to attach packing materials, not for closing outside of containers.

Pressure-Sensitive Plastic Tape - sticks to a variety of surfaces and shapes, good for sealing outside of containers.

Water Activated Paper Tape - use 3" width for sealing containers and attaching kraft paper.

Strapping Tape - only use for closing containers, do not use on exterior wrap of container.

c. Storage of Packing Materials

Keep packing materials in a clean, dust free, controlled environment. Parks should not accumulate excess packing materials if they cannot provide adequate storage for them. Wood crates and packaging materials absorb moisture and pollutants. If possible, store them in an environment with stable humidity between 40-65% RH. If crates have absorbed more moisture than is recommended for museum objects, allow the crate to acclimatize to an environment equivalent to the object's environment at least two weeks prior to shipment. Open the lid to speed interior adjustment. Before packing, check all materials for insect infestation.

6. Inventory List

Place an inventory of all contents inside the lid of each packing container. If the packing configuration is complicated and if unpacking in an incorrect order can cause damage, then include written unpacking instructions or a sequence of photographs showing the proper packing or unpacking techniques.

H. SHIPPING THE OBJECT

Park staff can pack museum objects with technical advice from the Regional Curator, Washington Office, Harpers Ferry Center, or local museums. Another option is to contract for packing services. However, keep in mind, that professional packers/shippers rarely match museum staff for knowledge of and sensitivity to objects. One of the most important factors in selecting a particular art packer or carrier is its reputation with other museums. After a company has been selected, discuss and confirm the following points of information about the shipment: size and weight limitations, insurance coverage, cost, payment terms, pick up and delivery times. The park should also specify to the carrier what standards are to be met. Finally, be prepared to supervise and give specific instructions for packing/shipping objects.

Park curatorial staff should inform the Regional Curator of positive and negative experiences with particular art packers and carriers so that a list of available packers and carriers can be kept current for referral to other parks.

1. Transportation Alternatives for Museum Objects

Options for transporting museum objects include: the U. S. Postal Service, United Parcel Service (UPS), motor freight, air freight, or courier. Selection depends on size, weight, distance, fragility of the object and extra services required. Specific features and limitations of the transportation alternatives are as follows:

a. The U.S. Postal Service is acceptable for objects that are not fragile and are not of high value. Always mail "priority" class to reduce transit time. A completed package must weigh less than 70 pounds and measure less than 108 inches in combined length and girth. Send object only by certified mail with a return receipt requested.

b. United Parcel Service (UPS) is recommended for shipping sturdy objects short distances (e.g., 100-500 miles). UPS will not transport objects of an "unusual value" or flammables/explosives. A completed package must weigh less than 70 pounds and measure less than 131 inches in combined length and girth. UPS offers next day delivery, second day delivery, as well as pick up and delivery service. An Acknowledgement of Delivery form is available to senders. All packages are automatically insured for $100 but additional insurance can be purchased. When shipping to a large institution, specify that delivery must be accepted by (signed for) by a specific person or department at the ultimate destination. Otherwise, objects may be left on a loading dock or at a reception desk.

c. Art shuttle vans and special product trucks offer transportation for museum objects. These services are offered by some national van lines and specialized art handling companies. However, they are subject to side routing, delay, and transfer between vehicles.

Find out, in advance, the exact route and transit schedule. Ship only in trucks that have air-ride suspension to absorb road shock. Transport objects sensitive to the environment in a climate controlled van. Cost for van shipping is based on size of shipment, weight, distance, and the extra services required such as pick-up, non-stop delivery, climate control and daily progress reports.

d. Air freight is a fast transportation method, but can be expensive and objects are subject to considerable handling. With air freight the object is out of the museum's control for the least amount of time. A typical scenario for an air freight journey is as follows: object is transported on a truck or van to the airport; it sits on a loading dock; a fork lift is used to carry it to the plane; it flies on the plane; (it may be transported on more than one plane before reaching its final destination); a forklift unloads it; it may sit for a time on the loading dock; a van takes it to the final destination. Air freight companies usually contract for pick up and delivery van service. Vans are not driven by museum art/object handlers. **Museum objects are handled like any other freight at this stage of travel. Pack objects with this fact in mind.**

   To prevent situations of unnecessary loading and unloading or a crate sitting unattended on a loading dock, plan routing carefully to minimize stop-overs and plane changes. Another threat is the pressure differences between ground and flight level which may affect pressure sensitive objects.

   Packing size limitations are related to the airplane configuration and its loading doors. Air shipment charges are normally determined by weight and dimension of the shipment. The services of an air-freight forwarder may be helpful to coordinate air and ground transport. These companies own no planes, but have offices and agents who book the services of all available airlines.

2. Use of Couriers

Use of couriers decrease the possibility of loss. To ensure its safety, a very fragile museum object, or one of high value, or one that is politically sensitive, should be accompanied by a courier during transit. A courier is also recommended if the trip is complex with many carrier changes. Someone knowledgeable in conservation, museum registration, and object handling techniques should serve as a courier. A courier may be a hired agent or an NPS employee.

When couriering objects on an airplane, it may be necessary to pay for an extra seat for the object. Check on airline size limitations before planning for a hand-carried shipment and a shipping container. Secure it with a seat belt unless the object can fit under the courier's seat. A courier never lets the object out of sight; does not carry hand luggage that gets in the way of the object, does not tell other passengers of the package contents; boards and disembarks

after other passengers. If the museum object is in the cargo section of an airplane, the courier supervises the loading and unloading and accompanies it from planeside to cargo shed. Such arrangements must be made in advance with the airlines.

Employee and park vehicles are sometimes used to transport museum objects from one location to another. Never leave a museum object unattended in the vehicle. Deliver it to its destination as quickly as possible, avoiding unnecessary intermediate stops. Try to minimize subjecting the object to drastic environmental changes, such as going from the climate controlled museum storeroom to a humid summer day and then to an air-conditioned car.

3. Receiving and Unpacking the Container

Museum objects arriving at the park should not be opened for 24 to 48 hours to allow the item to acclimatize to the new environment. After unpacking the objects, isolate and periodically examine them for signs of infestation. Set out sticky traps. Place objects on a white background to facilitate observing signs of active insect infestation (e.g., frass, insect parts, eggs). The length of time for isolation will vary based on the material and potential pests. Refer to Chapter 5, Section B for information on life histories of museum pests.

Use as much care in unpacking as in packing museum objects. Do not pull at pressure sensitive tape; carefully cut it to avoid excess pressure on the object and do not damage the object when cutting tape. Check objects against the packing list to ensure that everything is accounted for. Check and completely flatten all packing materials to ensure that no object pieces or small items are left behind. If the object is to be repacked, place packing materials inside the box or crate and save the container. Also take careful notes on the unpacking sequence and label all packing boxes and supports so that they can be reinstalled properly. Packing containers are specially designed for short-term trans- portation needs. **Park museums should not permanently store museum objects in packing containers.**

I. SELECTED BIBLIOGRAPHY

Dow Chemical U.S.A.
"Product and Design Data for Ethafoam Brand Polyethylene Foam," "Cushioning Packaging with Ethafoam," Fabricated Products Department, Midland, Michigan 48640.

Dudley, Dorothy
1979 Museum Registration Methods, Chapter 7: "Packing and Shipping." Washington, DC: American Association of Museums

Fall, Frieda Kay
1973 Art Objects: Their Care and Preservation, a Handbook for Museums and Collectors. LaJolla, CA: Laurence McGilvery.

Fall, Frieda Kay
1964 "General Rules for Handling Art Museum Objects," Museum News, Vol. 43, No. 1, pp. 33-39.

Gallery Association of New York State.
1985 Way to Go: Crating Artwork for Travel, Box 345, Hamilton, NY 13346-0345

Hansen, Greta and Piechota, Dennis V.
1982 "The Care of Cultural Property in Transit: A Case Design for Traveling Exhibitions," Technology and Conservation, Winter

Keck, Caroline K.
1970 Safeguarding Your Collection in Travel, Nashville: American Association of State and Local History

Lister, Joyce
1984 "Safekeeping Museum Collections: A Review of Handling," Museum Quarterly, summer, pp. 23-26.

Richard, Mervin J.
1983-84 "Elements for Effective Packing," Museologist, Vol. 45, No. 166, Winter

Rowlison, Eric B.
1975 "Rules for Handling Works of Art", Museum News, Vol. 53, No. 7, pp. 10-13.

Sandwith, Hermione, and Stainton, Sheila
1984 The National Trust Manual of Housekeeping. London: Allen Lane.

Shelley, Marjorie
1987 The Care and Handling of Art Objects, New York: The Metropolitan Museum of Art.

Stolow, Nathan
1981 _Procedures and Conservation Standards for Museum Collections in Transit and on Exhibition_, UNESCO

Stolow, Nathan
1987 _Conservation and Exhibitions-Packing, Transport, Storage and Environmental Considerations_, Museum and Monuments XVII, UNESCO, Boston: Butterworths

CHAPTER 7. MUSEUM COLLECTIONS STORAGE

A. INTRODUCTION TO MUSEUM COLLECTIONS STORAGE

Placing an object on exhibit usually demands some compromises in the conditions that are conducive for its preservation. However, it is a different matter with museum storage. Achieving ideal preservation conditions for objects housed in storage is possible. Good storage is the key to long-term preservation of a park's museum collections. **Good storage is preventive conservation.** A well-planned and organized storage space will not only reduce the risk of object deterioration, damage or loss because of improper storage techniques, poor handling practices, improper security measure, adverse environmental conditions, and biological infestation, but also ensures that the objects are accessible.

Preserving museum objects in storage involves looking at the total museum storage system used to house the collections. The museum storage system includes three levels: the facility, the equipment, and the container that houses the museum object. Although museum collections storage situations vary from park to park, the factors that need to be considered to properly house a collection remain the same. Each level of the system needs to be evaluated and adapted to meet the preservation and protection needs of each park's museum collection. The storage system must address in a practical way the space available to house the collections as well as the cost, both in funds and staff time available to each park. The levels of a park's museum storage system are illustrated in Figure 7.1.

Facility
- The structure
- The spaces within the structure
- The systems or infrastructure: mechanical, electrical, and utility

Museum Equipment (Furniture)
- Cabinets
- Shelving
- Specialized furniture

Containers
- Folders, sleeves
- Specimen trays
- Boxes
- Mounts, supports

Figure 7.1. Levels of a Museum Storage System

The NPS museum collection storage standard is as follows:

> Safe and secure storage of museum collections requires dedicated space. Museum storage areas must be used only for museum collections. Museum storage is separated from all other uses, including office space and research and work areas. Museum

collections require suitable and sufficient space. Generally, outbuildings, attics, basements, and closets do not contribute to the preservation and effective use of a collection. The space selected for museum storage is spatially adequate to accommodate the peculiar characteristics and quantity of objects and specimens. Adequate space is provided to accommodate reasonable growth of the collection. The space is organized to allow for the efficient use of curatorial equipment and techniques and to provide for effective access and optimum preservation of the museum collection. Objects are housed in appropriate containers and packaged with appropriate materials.

B. NPS MUSEUM COLLECTIONS STORAGE REQUIREMENTS

The requirements necessary to meet the NPS standards for storage of museum objects are outlined in the revised NPS "Inspection Checklist for Museum Storage and Exhibit Spaces." Refer to Appendix F for this checklist. This section provides guidance on those requirements.

1. Storage Space Must Be Dedicated

The space used for storing museum collections must be solely for the storage of museum objects. To the extent possible, office, research and work areas must be separated from the space housing museum objects. Flammable liquids and materials, curatorial supplies, audiovisual equipment, and other interpretive materials must be stored outside the museum storage space.

The storage must ensure appropriate environmental control and security. In many instances, a park will include a work area within the storage area. Combining storage and work areas is discouraged because of the following reasons:

a. Having people work in the storage area increases the number of air exchanges the area must undergo. Air exchanges cause temperature and relative humidity levels to fluctuate, resulting in the possible deterioration of objects.

b. Work areas require lighting levels that may cause damage to unprotected light sensitive objects.

c. Movement of people into and within the area brings in and disperses increased amounts of soil and dust into the air, which in turn, is deposited on surfaces of equipment and objects.

Therefore, a work area convenient to, but not included in, a storage area is strongly recommended.

2. Storage Space Requirements

a. In accordance with Executive Order 11988, "Floodplain Management," May 24, 1977, (40 CFR 6030), and the NPS Floodplain Management and Wetland Protection Guidelines, the facility used to store museum collections must not be located on a floodplain.

b. The collection must have suitable and sufficient space for proper storage. Suitable space means first-quality space. **First-quality space is planned space that has been evaluated for its adequacy for storing museum objects.** Outbuildings, closets, and unimproved basements and attics generally do not contribute to the preservation and effective use of a collection.

c. The characteristics of a good museum collections storage space are as follows:

- Space is environmentally adequate to maintain appropriate levels of relative humidity and temperature. Space is insulated and has a vapor barrier to help attain and maintain appropriate environmental conditions.

- Space has as few exterior walls as practical, to minimize the chance of condensation on walls and windows during seasonal and diurnal temperature changes, to enhance security, and to increase energy efficiency.

- Space has as few windows and doors as practical to enhance security and environmental control, but not so few as to cause any safety hazard in the event of fire.

- Space is free of water and sewer pipes and valves that can burst or leak and cause damage. Note: Water lines associated with fire suppression systems are allowed. Spaces equipped with fire sprinkler systems should have adequate floor drain(s) with backflow check valve(s).

- Space is free of electric junction boxes, gas and electric meters, and gas lines in order to limit the need for access by non-curatorial staff.

- Space has a heating, ventilating, and air conditioning (HVAC) system capable of maintaining the environmental requirements of the types of objects housed in the space.

- Space construction, as practical as possible, is fire-resistant or fireproof.

- Space allows movement of personnel, equipment and objects in and out without hindrances (e.g., inadequately sized doors, narrow, winding, or steep stairs or passageways with low ceilings).

- Space is sufficient in size to accommodate the existing collection as well as projected growth needs. Space size should be adequate to: allow use of proper storage equipment and techniques; incorporate proper width aisles between rows of equipment; and allow safe handling and movement of drawers, cabinet doors, and larger objects. An aisle width of at least 48" is recommended.

3. Protection Requirements

CFR 41--Public Contracts, Property Management, Subpart 114-60.4--"Storage of Property" addresses protection. Item (c) states:

"Types of property should be stored according to the kind of protection required. Protection requirements will vary greatly

with the types of commodities stocked. All items must be protected from fire and theft. Certain items require protection from dampness, heat, freezing, or extreme temperature changes. Others must be stored away from light and odors, protected from vermin infestation, or, because of their hazardous characteristics, stored separate from other stocks. These factors, as well as maximum protection of property against all causes of deterioration or destruction must be considered in selecting proper storage locations."

a. <u>Physical Security</u>

Entrances into the storage space should be equipped with metal or solid-core wooden doors that have dead bolt locks in addition to locking dead latches. The locks must have exclusive, non-mastered key cylinders. Keys to the storage area must be restricted to those staff members with direct museum responsibility. Small, highly sensitive and valuable objects should be kept in museum cabinets with keyed locks or in safes. All museum cabinets routinely should be kept locked. Isolated locations that may not be accessible and easily patrolled should be avoided as potential storage sites.

Access to the locked storage area must be limited to the museum staff and those people who have a legitimate reason to enter. Researchers and visitors should not be given general access to storage, and when in the space, they must be escorted. A visitor/researcher **sign-in log** needs to be established to record: visitor or researcher name, and address, the date and time entered, and time left, and reason for entering. When a researcher is working with objects, it is best that the objects be brought to a work area outside the storage space designated for the researcher. Refer to Chapter 9 of this handbook for guidance on access to museum collections. Ensure that the needs of the collection are included in the park's Emergency Operation Plan (EOP). Refer to Chapter 10 of this handbook for guidance on museum emergency planning.

The storage space must provide the collection with security from theft and vandalism. The storage area needs an intrusion detection system that is capable of alerting law enforcement personnel to ensure quick response in the event of unauthorized or unlawful entry.

b. <u>Fire Protection</u>

Collection storage space needs the safeguard of early fire detection and suppression to guarantee the safety of the collection and the personnel who use and care for it. The storage space must have the appropriate number of fire extinguishers for the area's size and the appropriate type for the materials stored. These should be conveniently placed, clearly marked, and properly maintained for emergency situations. All staff who might be

expected to use fire extinguishers must be trained in their use. Installation of a fire detection/suppression system that complies with the National Fire Protection Association (NFPA) guidelines will help ensure quick discovery and suppression by an extinguishing agent or rapid response by personnel. Refer to Chapter 9 for guidance on fire prevention, detection, and suppression systems.

The park's Structural Fire Plan should address pre-suppression emergency procedures such as the least destructive means of entering the facility; in what order of priority are objects to be removed if time is available to do so; what type of extinguishing agent is best to use to minimize damage to the collection; the location of nearest fire hydrants and hoses, and the training of staff in the use of appropriate extinguishing equipment.

Museum objects on shelving should not be closer than 18 inches from the ceiling. The use of fire-proofed dust covers on open shelving and the containment of objects in museum specimen cabinets is recommended.

Flammable liquids <u>must not</u> be stored in the storage area and, regardless of where stored, they need to be contained in approved flammable liquids storage cabinets that have been properly vented. Consult the NPS <u>Tools of the Trade</u> for information on flammable liquids storage cabinets.

4. <u>Environmental Requirements</u>

Maintaining an environment conducive to museum object preservation is both achievable and cost effective in a storage space. Many objects will spend much of their existence in a storage space. A proper collection storage environment is one that controls the range and reduces the fluctuations of temperature and relative humidity; prevents damage resulting from air pollutants and light; and eliminates biological infestations by insect and rodent pests. Refer to Chapters 4 and 5 of this handbook for guidance on monitoring and controlling the museum collections environment and on establishing an Integrated Pest Management (IPM) Program to monitor potential pest activity.

5. <u>Museum Equipment and Container Requirements</u>

The use of specialized storage equipment and containers will aid the park staff to preserve and effectively manage the museum collection. The use of proper storage cabinets, shelves, and racks will facilitate maximum use of the space and accessibility to the museum collection. The NPS "Tools of the Trade" provides a list of materials and equipment suitable for managing museum collections. It also provides a vendor address list. Refer to Sections D and E of this chapter for guidance on museum collections storage equipment and on museum object containers.

6. <u>Housekeeping</u>

There is always the possibility of <u>neglect</u> for objects not constantly on view to the staff. Good housekeeping in storage spaces is essential to a park's preventive conservation program. <u>Smoking, eating, and drinking must be strictly prohibited in storage</u>. Storage needs to be routinely checked for signs of pest infestation. An integrated pest management program should be implemented or in effect. The storage area including cabinets and shelving should be routinely dusted and vacuumed. Floors need to be vacuumed and mopped regularly to reduce levels of dust and soil.

C. MUSEUM COLLECTIONS STORAGE PLANNING

Planning for museum storage is essential to ensure preservation and access to the collections. The process of collections storage planning may focus on the development of a new facility, the rehabilitation of an existing facility, or only on a specific aspect of museum storage (e.g., determining equipment and space requirements for a collection, outlining specific techniques for housing museum objects on shelves or in cabinets). In the National Park Service, the product of planning may be a comprehensive Collection Storage Plan (CSP), a section on museum storage in a Collection Management Plan (CMP), or a brief paper that includes a floor plan and a list of needed equipment. However, regardless of the product, all or some of the elements of a CSP are incorporated into the planning process.

1. The Collection Storage Plan

The Collection Storage Plan is designed to assist a park in improving the storage conditions for a museum collection. It evaluates the condition of the park's existing storage spaces, compares the existing conditions with the NPS standards and requirements for proper storage, identifies various alternatives to meet the standards, and recommends the alternative that best satisfies the requirements. The specific nature of the collection and the availability of funding and staffing are factors to consider when selecting an alternative. The plan also addresses specific techniques for housing the collection within the space and the museum equipment. Elements of this plan are always included with a Collection Management Plan (CMP). However, it also may be prepared as a stand-alone document to solve urgent collection storage problems before a CMP is prepared, or to design a new collection storage facility. The Collection Storage Plan includes the following components:

a. Assessment of the nature of the collection
b. Assessment of the existing storage facility
c. Assessment of the existing storage conditions
d. Assessment of existing storage equipment and recommendations for additional or replacement equipment
e. Assessment of object storage techniques and recommendations for better techniques.
f. Identification and discussion of storage space alternatives
g. Discussion of the specific recommended alternative

2. Assistance in Writing a Collection Storage Plan

Park curatorial staff can write this plan or can request that the plan be prepared by NPS curatorial staff from outside the park or by procuring the services of a museum professional with expertise appropriate to the nature and needs of the park's collection. Contact the Regional Curator for assistance in writing this plan.

Contact the Curatorial Services Division, Harpers Ferry Office, for technical information and examples of Collection Storage Plans.

3. Writing a Collection Storage Plan

Use the following format to prepare a Collection Storage Plan. Preparing this plan requires assessing the museum collection and the facility and spaces housing the collection.

a. Assessment of the Nature of the Collection

Examine the entire collection with emphasis on objects designated for storage but consider all those objects that may eventually be placed in storage. Describe the types of objects, the quantities of each object type, the relative sizes and required volumes for storage. An example of relative size is as follows: Two types of historical wood and metal composite objects are a hammer and a wagon. Both fit into one major category of history, however, each object type has different storage requirements and containment needs. Describe object types by discipline and material makeup. Note and list types of objects that are extremely sensitive to the environmental influences of temperature and relative humidity, light, and air pollution.

Identify the types and approximate quantities of objects that the park plans to acquire in the future. Study the park's approved Scope of Collection Statement for this information. In addition, consider the return of outgoing loans and any temporary transfers, and loans, future archeological and natural science research projects that may increase the size of the collection.

b. **Assessment of the Storage Facility**

Describe the existing storage facility and conditions of storage space.

1) Describe the existing structure(s) and space(s) within each structure that are used for museum collections storage. Information in this section includes:

- Describe the structure's construction and fabric (e.g., wood, masonry, two-story, one-story).

- Record the overall dimensions of the space and the ceiling height and type (e.g., 8′ dropped ceiling).

- Describe the number and size of access doors (e.g., measure all doors that objects will pass through).

- Determine with the assistance of an architect or engineer, if the structural strength will safely withstand the loads associated with the collections to be stored; this is especially important for second floors in a structure.

Ceramics, metals, paper, glass, and wood objects in great volumes produce a great deal of weight.

- Describe any characteristics of the structure that would hinder the movement of objects or equipment. Stairs may make difficult the movement of objects, especially large and heavy ones. Such access routes also increase the risk of accidental breakage.

- Describe sizes and directional orientation of windows, and note types of glazing (e.g., glass, plexiglas).

- Describe any electrical service and plumbing fixtures and determine if existing electric service has capacity for add-on functions such as air-conditioners, humidifiers, dehumidifiers, additional lighting.

- Describe wall coverings (e.g., dry wall, plaster, brick, paneling). Some wall coverings and construction are more fire-resistant and secure than others.

- Describe type and location of light fixtures (e.g., incandescent, fluorescent, combination).

2) Illustrate the existing space utilization.

Prepare a floorplan that indicates the following information:

- The dimensions and arrangement of storage areas, including structural features that may restrict arrangements of equipment and must be worked around (e.g., structural posts, beams, conduit, drains).

- The location of doors, stairs, and windows.

- The location of electrical service (e.g., conduit, outlets, switches, fixtures, and panel boxes) and plumbing (e.g., pipes, valves, and drains).

- The dimensions and existing location of museum specimen cabinets and shelving, including aisle widths.

- The location of fire detectors/suppression nozzles, fire extinguishers, and security devices.

- Note the location of environmental monitoring and control equipment.

Refer to Figure 7.2, 7.3, and 7.4 for sample floor plans.

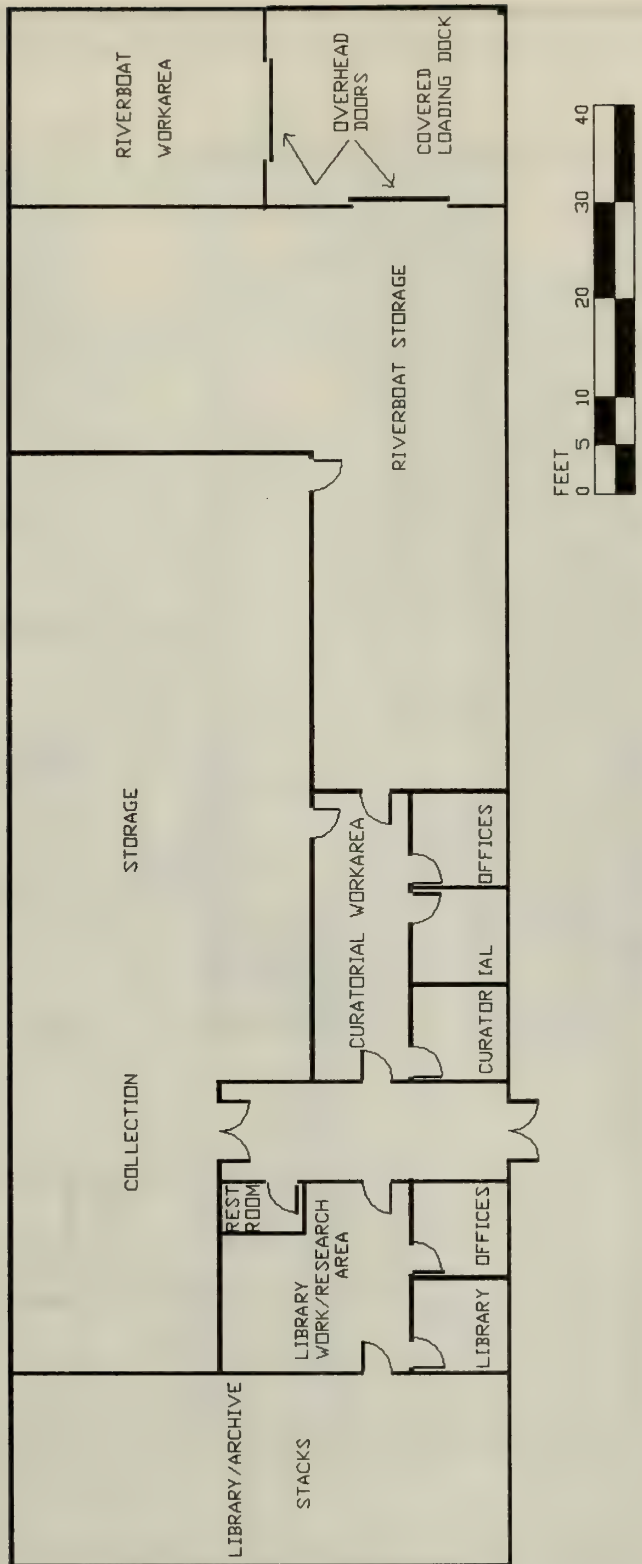


Figure 7.2. General Floor Plan of Proposed Museum Collection and Library Center at Grand Canyon National Park. Drawn with Autocad® Computer Assisted Design Program.

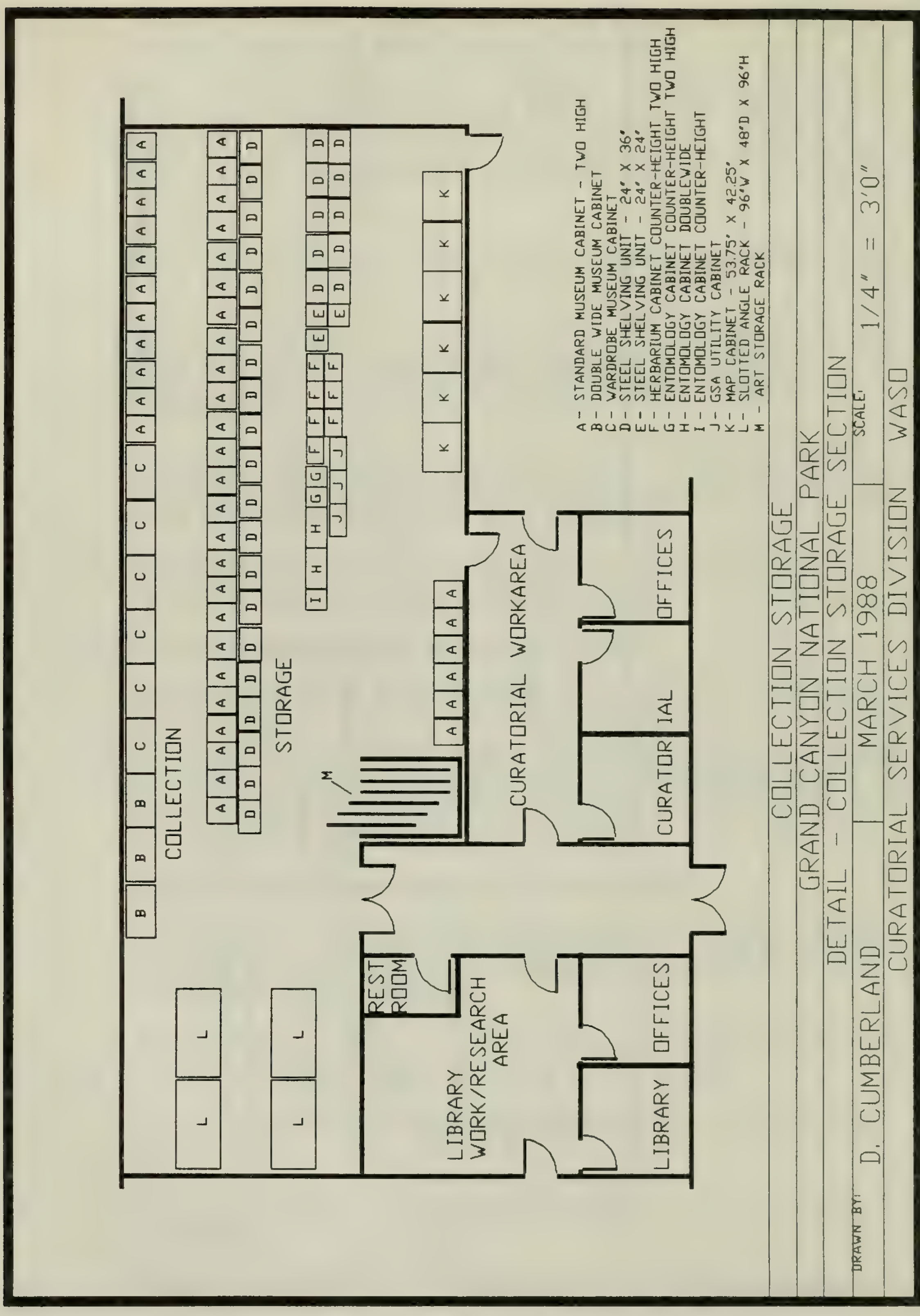


Figure 7.3. Floor Plan of Proposed Museum Collection Space at Grand Canyon National Park. Drawn with Autocad® Computer Assisted Design Program.

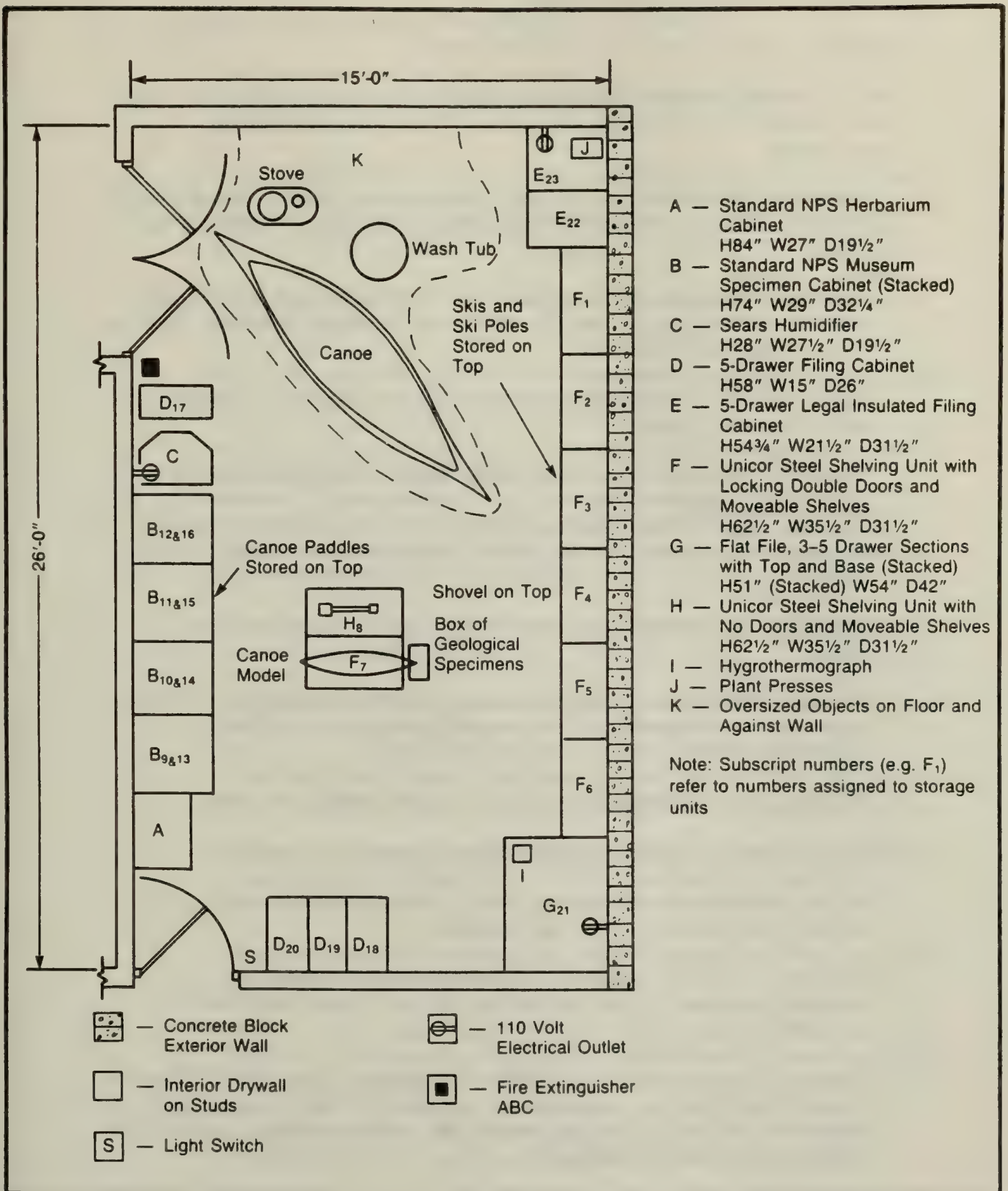


Figure 7.4. Floor Plan of Museum Collection Storage Room at Voyageurs National Park (Scale: ¼"=1'0"). Floor plan shows existing museum equipment and oversized objects.

c. **Assessment of Storage Conditions**

1) Assess physical security for the space.

   This information should be included in an appendix to the plan. Restricting distribution of this information should be considered.

   - Describe the intrusion alarm system (e.g., type, location of sensors, nature of monitoring, who responds, and response time).

   - Describe the construction and locking system of door frames and the doors (e.g., metal, solid-core wooden, wooden hollow core, dead bolt locks).

   - Describe how windows are secured (e.g., latches, covered with plywood, bars,).

   - Identify the park staff who have keys to storage area and park staff who have access to storage areas. Indicate whether staff from other divisions need to enter or pass through the area to access major junction boxes or cleaning supplies.

   - Describe any other functions that occur in the storage space.

   - If applicable, describe any areas in the storage space where security is compromised because of easy access from an adjoining space (e.g., dropped ceiling).

   - Note if visitor/researcher log is used and maintained.

2) Describe the current fire detection/suppression system.

   - Describe the type of system (e.g., wet pipe sprinkler, Halon, ionization, heat activated).

   - Determine how the detection alarm is monitored, the responsible party for responding to an alarm, and the response time.

   - Check to ensure that the park's Structural Fire Plan clearly identifies the pre-suppression action for the responding authorities (e.g., how to enter the storage space, priority list for evacuating objects).

   - Identify the number, types, and locations of hand-held fire extinguishers.

   - Identify the closest water supply available to suppress a fire.

3) Assess environmental monitoring and control.

- Include the following information: readings for temperature, relative humidity and light levels of the existing space.

- Note and describe levels of dust and possible sources of dust. Obtain from the Environmental Protection Agency or a local agency measurements for sulfur dioxide, hydrogen sulfide, and oxides of nitrogen.

- Note any history of or present evidences of biological infestation.

- Note the location of the environmental monitoring equipment (e.g., hygrothermograph, hygrometer).

- Check to ensure that environmental monitoring equipment is properly calibrated and maintained.

- Examine the data recorded on temperature and relative humidity, light, and pests within space. In particular note the following information:

  - The annual maximum and minimum temperature readings and relative humidity levels.

  - The monthly maximum and minimum temperature readings and relative humidity levels.

  - The maximum diurnal (24 hour) fluctuation for temperature and relative humidity on a monthly and an annual basis.

  - Do the records indicate the maintenance of a proper environment because of climate control systems (e.g., heating, ventilating, air-conditioning [HVAC])?

  - Do the records indicate diurnal changes if HVAC equipment is turned off after working hours?

  - The data on visible and UV light levels in the storage space. If there are windows in the space, have readings been recorded for both winter and summer months?

  - If appropriate, examine data available on pollutant readings from a number of years. Note any trends.

- Describe the space's air-handling system (e.g., type of system: heating and air-conditioning, oil-fired furnace, heat pump, central air). Note whether system is dedicated to controlling the space's environment. Note location of the thermostat. Note the location of discharge and return

registers. Note how the air is filtered. Obtain manufacturers data on equipment (e.g., literature, operating manual). Determine maintenance history of equipment.

- Determine if portable dehumidifiers, humidifiers, or air-purifiers are used in the space, and analyze the records to determine if the equipment has had any impact on improving conditions.

- Describe type of dust covers used to protect objects stored on open shelving (e.g., plastic, muslin).

- Check fluorescent lighting to ensure that light filters are installed. Use light meter to ensure that filters are controlling ultraviolet radiation levels.

- If there are windows in the space check to see if, blinds, curtains or light filters have been installed.

- Check to ensure that an Integrated Pest Management Program has been implemented in the space. Note data that has been recorded on types of pests that have been observed in the traps.

d. **Assessment of Existing Museum Equipment**

- List the types of existing storage equipment (e.g., museum specimen cabinets, map cabinets, file cabinets, shelving, painting racks, high density storage systems).

- Note the manufacturer and model number of each type of equipment, and, if the equipment is non-standard, its size (e.g., width, depth, and height).

- Note the condition of the equipment (e.g., operation of locks, condition of gaskets, evidence of rust, dents, holes, scratches).

- List any equipment that needs to be replaced.

- Indicate additional museum equipment that is or will be needed to properly store the existing collection and future growth in the collection.

- Determine if any specialized equipment or adaptations to equipment are needed to house specific types of objects, (e.g., additional space might be provided by installing a high density storage system or by installing racks to store objects on a wall).

- Determine if a rearrangement of the equipment will better use the existing space.

- List the types and numbers of equipment used to monitor temperature and relative humidity and types of portable equipment used to achieve required environmental levels.

- Note the type of equipment that is used in the housekeeping program for the space (e.g., vacuum cleaner, mops, buckets, brooms, dust mops).

e. **Assessment of Object Storage Techniques**

- Determine if the space within the existing museum equipment is effectively used.

- Examine the space utilization and make recommendations for more effective use of existing shelving and cabinets.

- Identify any material that is not part of the museum collection and recommend its removal from storage space.

- Evaluate techniques to house the objects (e.g., containers, enclosures, mounts, supports, appropriate storage materials). Recommend methods for improving techniques.

f. **Identification and Discussion of Storage Space Alternatives**

Consider all alternative locations for museum collections storage. Visit and examine each possible location and record pertinent data. Indicate capability of each alternative space to satisfy NPS storage standards.

This section of the plan needs to address the following approaches to storing the collection:

1) No change in the existing storage space and a listing of possible consequences.

2) Modification of existing storage space. Provide details of the required changes. Describe how existing conditions can be corrected to conform to NPS standards.

3) New storage locations in the park and a description of the actions needed to adapt space(s) to conform to NPS standards. Consider the following approaches. In each instance, gather and record the pertinent information needed to assess the appropriateness of the space.

   - Different spaces in same structure

   - Different structures in the park

   - New space in a new structure (e.g., Visitor Center, Research Center)

- Specialized structures (e.g., prefabricated insulated buildings) or a new or retrofitted facility.

For each approach, prepare a new floor plan that indicates arrangement of museum equipment (e.g., cabinets, shelving, racks) windows, doors, electrical outlets, and lighting.

4) Storage in an existing facility outside the park (e.g., repository in another park, a regional NPS collections repository, a non-NPS repository).

g. **Discussion of the Specific Recommended Alternative**

The recommendations for the storage space should be made on a priority or weighted basis for the various alternatives. For each alternative, indicate the reason or justification for this choice. Indicate the most acceptable approach to improving the storage conditions.

Consider phasing the project to allow improvements to occur as funding becomes available (e.g., rehabilitate the space one year; install environmental control equipment and security and fire protection systems in a second year, purchase replacement and new equipment in the third year). Once an alternative is chosen, prepare and incorporate a project statement in the park's Resources Management Plan. Prepare appropriate programming documents. Refer to Chapters 1 and 12 of this handbook for guidance on NPS planning documents and programming and funding curatorial projects.

h. **Appendices Containing Technical Information**

Include in this section proposed storage configurations, product/source information, environmental monitoring data, and illustrations for constructing specialized equipment. Consult the Regional Curator and the Curatorial Services Division for assistance in gathering material for appendices.

4. <u>Alternate Storage Locations</u>

NPS parks, in most instances, maintain and store museum collections that are identified in the park's approved Scope of Collection Statement. Museum collections, as a rule, serve the park better if they are housed on-site.

There are circumstances when collections may be stored in an off-site repository. When a park has no acceptable space to house objects safely and when a park has no qualified curatorial staff to provide day to day care for the collection, it may be necessary to house park collections in an NPS regional collections repository.

Archeological collections recovered systematically from within a park's boundaries may be housed in off-site storage repositories.

This is especially the case where archeological projects result in a large collection of materials that require considerable space for processing and analysis. To provide space to accommodate these materials and space to conduct archeological research by both NPS staff and visiting scholars, the Service operates centralized repositories in various areas of the country to serve the majority of parks. These centers include the Southeast Archeological Center (Tallahassee, FL), the Midwest Archeological Center (Lincoln, NE), and the Western Archeological and Conservation Center (Tucson, AZ). These centers manage and preserve collections that are loaned from parks. The National Capital Region operates a repository--Museum and Archeological Regional Storage Facility (MARS)--that provides space for the storage of museum collections from parks that do not have the appropriate funding or staff to care for museum collections in storage.

In addition the Service can arrange with non-NPS repositories for the storage and curation of collections. Institutions that house park museum collections must meet NPS standards and requirements for museum object preservation and protection.

D. HOUSING MUSEUM OBJECTS

1. Museum Storage Equipment

A wide variety of museum cabinets and shelving are available for storing all types of museum objects. The NPS Tools of the Trade states: "Specialized museum cabinets have synthetic gaskets that create an interior microenvironment that buffers temperature and relative humidity fluctuations, prevents insect and vermin infestations, and prevents damage caused by light, dust, and pollution. Shelving units are used to store objects too large or heavy to fit within museum storage cabinets. Special racks will accommodate hard-to-store objects."

The National Park Service uses three primary types of cabinets to form a basic modular system that facilitates efficient organization and access to the objects. Refer to NPS Conserve O Gram 4/4, "Modular Concept of Museum Specimen Storage Cabinets." These three cabinets are as follows: a standard museum cabinet, a doublewide museum cabinet, and a wardrobe cabinet. In addition, there are entomology and herbarium cabinets, map cabinets, large flat storage cabinets, and utility cabinets. Refer to the NPS Tools of the Trade for descriptions and sources of available museum cabinetry.

Several types of shelving are available. Refer to the NPS Tools of the Trade for descriptions and sources of available museum shelving. Slotted angle racks are particularly useful. These racks are constructed using slotted metal angle that can be custom cut. They can be specially configured and constructed for extra large artifacts or for objects with specific support or space requirements. Shelving can be made from metal panels or with plywood coated with a two component epoxy paint.

A prefabricated building system can be assembled inside a building or outside to create a collection storage facility that is economical to construct, efficient to operate, and effective in creating appropriate environmental conditions. The building system is made of superinsulated, foam core, metal-sheathed panels. NPS Preservation Tech Note, "Museum Collection Storage in an Historic Building Using a Prefabricated Structure," listed in Section E of this chapter, discusses the application of this special building to museum storage. The NPS Tools of the Trade provides information on the source of this building.

2. General Considerations

a. In planning for cabinets and shelving, examine all objects in the collection. To the extent possible, organize objects by material type and size rather than by provenience or accession/catalog information.

b. Ideally, do not install cabinets and shelving units against exterior walls. This situation may lead to condensation.

c. Ensure that museum cabinets are free of rust, have gaskets intact to provide good sealing action, have smooth operating doors, and have working keyed or combination lock mechanisms. Early museum specimen cabinets used polyurethane foam gaskets that deteriorate over time. These gaskets should be replaced. The Curatorial Services Division provides retrofit gasket kits. Refer to NPS Conserve O Gram 4/8, "Installing the Retrofit Kit."

d. Keep loads in museum cabinet drawers below 50 pounds. Ensure that museum cabinets are not stacked more than two high. Ensure that museum cabinets and shelving units are raised off the floor at least four inches (preferable six inches). Raising cabinets reduces the chances of damage to objects in case of flooding and facilitates the cleaning of floors and inspection for pest problems.

e. Ensure that closed cell polyethylene foam is used in museum cabinet drawers and on shelving to cushion objects. Ensure that objects in museum cabinets are placed in specimen trays, padded, or otherwise prevented from sliding or shifting when drawers are opened and closed. Refer to the NPS Tools of the Trade for sources of foam and museum specimen trays.

f. Facilitate locating museum objects by assigning and affixing a unique number to all shelving units, individual shelves, cabinets, and individual cabinet drawers.

3. Techniques for Storing Museum Objects

The appendices in this handbook that address curatorial care of different types of objects provide guidance on techniques for housing museum objects in storage. The selected bibliography included in each technical appendix provides additional references for the care and storage of each type of material. The materials recommended for use are listed in the NPS Tools of the Trade or in the technical appendix. Figures 7.5, 7.6, 7.7, 7.8, 7.9, and 7.10 illustrate some of the equipment and techniques for storing museum objects.

Figure 7.5. Cavity storage technique used to house small objects in a standard museum cabinet drawer.

Figure 7.6. Wardrobe museum cabinet storage assemblies that are designed to house rolled textile objects.

Figure 7.7. Larger objects housed on steel shelving. Note that the metal surfaces are lined with polyethylene foam. Both plastic and muslin dust covers can be used to protect objects from dust.

Figure 7.8. A five-drawer map cabinet with a map enclosed in an acid-free document folder.

Figure 7.9. Slotted angle iron can be used to construct racks for furniture and other large objects. This versatile material also can be used to fabricate custom designed storage equipment such as the rolling unit for the hall stand illustrated in this figure.

Figure 7.10. Painting/framed objects rack constructed of slotted angle iron and 2" mesh welded wire fencing.

E. SELECTED BIBLIOGRAPHY

Cumberland, Donald C.
1980 "Modular Concept of Museum Specimen Storage Cabinets," NPS Conserve O Gram 4/4. Washington, D.C.: National Park Service, Curatorial Services Division.

________.
1989 "Installing the Retrofit Gasket Kit," NPS Conserve O Gram 4/8. Washington, D.C.: National Park Service, Curatorial Services Division.

________.
1985 "Museum Collection Storage in am Historic Building Using a Prefabricated Structure," Preservation Tech Notes, Museum Collection Storage, Number 1. Washington, D.C.: National Park Service, Preservation Assistance Division.

Hilberry, John D. and Weinberg, Susan Kalb
1959 "Museum Collection Storage," Museum News (May) 7-21; (June) 5-23; and (July) 49-60. Washington, D.C.: The American Association of Museums.

Johnson, E. Verner and Horgan, Joanne C.
1979 Museum Collections Storage. Paris, France: United Nations Educational, Scientific, and Cultural Organization (UNESCO).

Lewis, Ralph H.
1976 Manual for Museums, 91-104. Washington, D.C.: National Park Service.

Sullivan, Brigid
1990 "Protecting Museum Collections in Storage," Local History Notebook (May/June), 6:2. Columbus, Ohio: The Ohio Historical Society.

CHAPTER 8. MUSEUM OBJECT CONSERVATION TREATMENT

A. INTRODUCTION TO MUSEUM OBJECT CONSERVATION TREATMENT

The primary goal of the conservation of museum objects in NPS collections is to preserve their historic, scientific, or esthetic identity, as embodied in surviving features of composition, structure, form, appearance, or workmanship. This emphasis on preservation follows from the recognition of museum objects as "primary sources" for archeological, historical, and scientific research, or as the means of experiencing authentic, firsthand contact with the events and people commemorated by a park. Refer to Appendix A, Section B for excerpts from NPS Management Policies (Dec 88) relevant to the treatment of museum objects.

Conservation treatment is the interventive ("hands-on") work of preserving or restoring museum objects, and usually requires the services of a conservator who is trained and experienced in dealing with the problems of a particular class of objects (e.g., paintings, textiles, furniture, photographs, books, ethnographic objects, natural history specimens). All conservation treatment must be carried out in accordance with the principles and practices specified in the Code of Ethics and Standards of Practice of the American Institute for Conservation of Historic and Artistic Works. Refer to Appendix E for a copy of this code of ethics.

However, park staff always retain the responsibility for ensuring that museum objects receive proper care. There should be close cooperation and teamwork between curatorial staff and the conservator throughout the treatment process. The role of park staff is to ensure that objects receive the treatment necessary for their preservation and use; that each treatment is appropriate, taking into account an object's condition, history, significance, and role in the collection; and that treatments are competently performed and documented. Curatorial staff have a continuing role in ensuring that all object conservation treatments meet these standards.

1. Preservation and Restoration Treatment

   As stated in Chapter 3, object conservation in the National Park Service is an ongoing process of preventive conservation supplemented by conservation treatment when necessary. The key to an effective conservation program is preventive conservation. When exhibit and storage environments are suitable and the staff is careful, the need for treatment will be considerably reduced. Some objects have inherent faults that hasten deterioration or have problems associated with earlier treatment or maintenance efforts, but more often it is neglect that necessitates treatment. Conservation treatment should be considered supplemental care that some objects may need beyond a good program of preventive conservation. In this context, stabilization treatment is indicated under the following circumstances:

   a. When preventive measures, such as good environmental conditions and proper handling, are not enough to reduce the rate of deterioration to a tolerable level, and there is a satisfactory

treatment available to prolong the life of the object. An example is the deacidification of wood pulp paper. Industrialized paper making produces paper high in acid content, and this has resulted in the rapid deterioration of books, documents, and other paper objects, even in good environmental conditions. Various treatment techniques involving deacidification have been developed.

b. When deterioration has proceeded to a point where the object is extremely fragile and in danger under any circumstances, and a satisfactory treatment is available to increase its stability or durability. For example, loose paint flakes may need only the slightest touch to fall and be lost from a painting. Therefore, treatment is needed.

c. When exhibit or research needs or conditions require corrective work such as cleaning, reassembly of broken parts, or a greater degree of physical stability to allow more handling or permit the object to be exhibited satisfactorily. For example, a flag may need special support to be exhibited vertically, or a metal artifact recovered from an archeological site may need cleaning to reveal important markings.

In addition to preventive care and stabilization treatment, some amount of restoration may be desirable to permit an object to be better understood or appreciated. Restoration usually means removing additions which are not considered historically important, so far as an individual object is concerned, or replacing missing parts, "renewing" finishes, concealing damages, and so on. Ethical considerations as well as NPS Management Policies (Dec 88) call for restoration treatment to be the minimum necessary, fully documented and without fraudulent intent.

2. Minimum Treatment Necessary

Once the need for treatment and the goals of treatment are clearly established, a preservation-oriented policy is to keep interventive treatment to a minimum. "Minimal intervention" is the treatment strategy of doing the least possible to the object that in any way alters its significant characteristics. The goal is to reduce the possibility that the treatment itself will in some way compromise the valuable aspects of the object or eventually result in more rapid deterioration.

Conservators are aware of the fact that previous efforts at repair, restoration, and stabilization often have been detrimental to the long-term preservation of museum objects. In many cases, no treatment at all would have been better. Many treatment materials and techniques have not stood the test of time, and objects not yet in collections were cared for with no thought to long-term preservation needs. As a consequence, significant features of objects have been sacrificed or altered permanently. Later it is realized that something important has been lost, or that future preservation has been made more difficult and uncertain.

With any interventive treatment, even when preservation is the goal, there is a chance that information will be destroyed or the object may be altered so as to decrease its long-term value in unforseen ways. Objects are often re-evaluated by succeeding generations. Also objects may provide new information as research techniques improve.

With a "minimal intervention" approach to treatment, an object's exhibit or storage circumstances are also considered. In this way, it is sometimes possible to avoid interventive treatment entirely. For example, a change in the way an object is supported, or some modification in its immediate environment, may be sufficient to stabilize its condition or make it safely exhibitable. The underlying problem is that treatment processes may not be completely reversible. Cleaning, for example, cannot be undone. Conversely, the oils, resins, gums, and waxes introduced into objects may be only partially removable later on, and may present an obstacle to new treatment processes which have become "state-of-the-art."

B. FACTORS TO CONSIDER BEFORE OBJECT TREATMENT

1. Changing Guidelines for Treatment

In recent years the question of what constitutes appropriate treatment of individual museum objects has become more complex and requires increased curatorial involvement. Objects now are seen in a wider context which includes consideration of historical and scientific factors, as well as the esthetic ones which used to guide almost all treatment.

The typical mandate for restorers used to be simple. They were to make objects "look good" for exhibit, according to the fashions of the times. (Utilitarian objects, in addition, were to be put into working order.) This approach often meant treatment was "cosmetic" in nature and did not focus on an object's long-term preservation needs. Accompanying this emphasis on visual features or esthetics was a carelessness about keeping the historical record straight. Many objects were altered according to contemporary esthetic considerations, rather than scrupulously preserved to document the history of styles, taste, workmanship, or remain valuable in other ways as "primary source" objects.

In museum collections today, many objects are preserved because they document technological achievements or provide data for historical or scientific research. In addition to use in exhibits, these objects have worth as cultural artifacts because they present historical evidence and scientific information. Treatment which emphasizes only the appearance of such objects may be misdirected and inappropriate. Therefore, it is essential that the curator and the conservator share their knowledge and consider all technical, historic, and scientific, as well as esthetic aspects, in order to decide what treatment is appropriate for each object.

2. Appropriate Treatment

Factors to be weighed in considering what constitutes appropriate treatment for a particular object include the following:

a. Objects documenting history of technology

Objects may contain various kinds of information indicating how they were made and used. In addition to an object's design features and its composition, there may be evidence relating to the sources and processing of its raw materials, as well as fabrication or manufacturing techniques. Other evidence may include accretions, signs of wear, and repairs or alterations.

Important information may exist in the form of paint markings, residues of associated materials, grime, metallurgical features, and easily lost remnants of every sort. Curatorial staff should alert the conservator when dealing with objects of this kind.

b. Objects having functional capability

Some objects are collected and preserved because of a special function they can perform. For example, the capacity to produce musical sounds of a particular quality may be what makes a certain musical instrument important in a collection, and this will guide the choice of treatment. Another instrument may be important as an example of fine woodworking or have a special historical association, and this may require a treatment approach that emphasizes preserving original material, regardless of whether it is deteriorated to the point of preventing the instrument from being played. It is important to realize that the preservation of functional capability may require replacement of worn out or defective <u>original</u> parts. Parts wear out when objects are in working condition and are used. Answer the question: Does preservation of function take precedence over preservation of the original "fabric" or material?

c. Objects having scientific research value

There are large numbers of objects in anthropological, natural history, and historical collections which are preserved for a variety of research and study purposes. Since the full research value of an object may not be known, and any alteration (e.g., cleaning) may destroy data, appropriate treatment will mean minimal intervention, if any treatment at all can be justified.

d. Ethnographic objects

In some collections, there may be objects considered significant by Native Americans or other people. Modern conservation treatment may not be appropriate for these objects since, from the point of view of the cultural group in question, treatment may have an adverse effect on value or potential function of the object. There also may be a concern about who performs the treatment: a member of the community or an outsider.

Park curatorial staff need to identify the culturally relevant group for all ethnographic objects. A qualified ethnographer should be consulted to help identify relevant groups, materials, community consultants, and questions to be raised. Consultation with representatives of these Native American or other groups should be sought to identify significant objects and determine appropriate treatments. When in doubt, interventive treatment should be kept to a minimum, in a context of adequate preventive measures, until more is known about the objects.

e. Importance of appearance

For many objects, appearance <u>is</u> a high priority in conservation treatment. This is true not only for fine arts and decorative objects, which are valued for esthetic reasons, but also for many other objects. In exhibits, appearance is almost always an aspect

of an object's role, and at minimum most objects receive some "grooming" to make them more presentable. For instance, appearance becomes a factor when unused, undamaged, new-looking objects are wanted for exhibit. Or in other cases it may be desirable to see wear and tear, or other signs of use.

Expectations of the curator about after-treatment appearance may be easily fulfilled when intact, relatively stable objects are treated. Ceramic objects, for example, may sometimes be in close-to-original condition, their appearances preserved intact. Problems arise with the many museum objects whose appearances are transitory, due to the inherent instability of their constituent materials, or have substantially changed because of use, abuse, neglect or subsequent repairs. The original or historically important appearance may have been lost. Objects made of organic materials, for example, usually start to deteriorate as soon as they are made, and continue deteriorating after their historically important period of use has ended. Utilitarian objects may show non-period wear and tear, repairs, and modifications, aside from any changes due to inherent instability. Answer the following questions: What does it mean to restore the former appearance of such objects? When does this effort become fraudulent and unethical for a museum object?

During the examination prior to treatment, the conservator will try to ascertain the condition of the constituent materials of an object and to what extent, if any, an object's original visual features are still present, though perhaps hidden under grime or extraneous additions. Subsequent to this examination, decisions about the extent and character of any proposed restoration need the full participation of the staff member who has curatorial responsibility for the object in question.

3. Guidelines for Restoration Treatment

In accordance with conservation ethics and with NPS <u>Management Policies</u> (Dec 88), the following guidelines are to be used in making decisions about restoration treatment:

a. Restoration of an object shall be based on sufficient data with a minimum of conjecture.

b. Restoration shall not modify the known original character of an object.

c. Restoration will be minimally interventive. Restoration techniques and materials shall be chosen that least modify the original object; and materials used shall be the most completely removable at a later time with minimum effect or harm to an object.

d. Restored areas of an object shall be distinguishable from original material, although they need not be conspicuous. Restored areas shall be fully documented in an object's treatment report.

e. Restoration of an object shall take into account the possible importance of preserving signs of wear, damage, former maintenance, or other historic or scientific evidence.

f. Wear, breakage, discoloration, and other deterioration do not necessarily affect the value of original material. When deteriorated original material is perceived to impede satisfactory restoration, the curatorial staff must ensure that the irreversible alteration or destruction of such material will not diminish the historical or scientific value of the object.

g. Restoration should not mislead the visitor. Without expert guidance, restored areas of an object may be confused with original areas. Restoration, even if accurate in a general way, may be inaccurate in its details. Extensive restoration may overshadow evidence revealed by the object about original technology, materials, and fabrication skills. These may be among the object's most important features.

4. <u>Conservation Treatment vs. Routine Maintenance</u>

Many objects which are now in museum collections were formerly in use in the everyday world where they underwent some form of "routine maintenance." As utilitarian objects, they usually needed repair and a certain amount of upkeep in order to remain useful. Examples are horse tack, automobiles, and bed linens.

However, the customary procedures for the routine maintenance of objects still in use may not be the procedures which will promote long-term preservation in a museum collection. Original parts of utilitarian objects are replaced when worn out or defective. These objects undergo modifications, lubrications, frequent cleaning, or whatever is necessary to keep them operational or serviceable until they wear out.

The circumstances are different in a museum collection where objects are taken out of everyday use and receive care so that preservation may be long-term, with ongoing possibilities for study or exhibition. In other words, because the goals are different, the procedures and materials for care may be different. When a utilitarian object enters a museum collection, routine care and maintenance is best determined by the park's curatorial staff in consultation with a conservator.

C. DOCUMENTATION OF OBJECT CONSERVATION TREATMENT

Conservation treatments must be documented in writing. An adequate treatment record also may require photographs. This requirement applies not only to treatments carried out by conservators, but also to any care administered by curators. There is no standard format for conservation reports. Both checklist and narrative essay report types are used by conservators. NPS conservation treatment policy follows the guidelines for documentation presented in the Standards for Practice of the American Institute for Conservation (AIC).

File all conservation treatment documentation (e.g., examination report, treatment proposals, and treatment reports) in the appropriate Accession File or Catalog Folder as required by the NPS Museum Handbook, Part II, Chapter 2.

1. Importance of Documentation

    a. It provides the curatorial staff with information on the condition of the object, how its original state has been altered, what is original fabric and what is old restoration.

    b. It serves as a permanent record of the treatment procedures performed and the materials and methods used.

    c. It spells out the understanding reached between the curatorial staff and the conservator on the scope of work, including the extent and type of any stabilization or restoration treatment.

    d. It makes possible the assessment of the success or failure of treatment methods and materials over a long period of time. It provides information which will help future conservators in assessing an object's condition and devising further treatment.

    e. In some instances it may last longer than the object itself and may become the only remaining record.

2. Means of Documentation

    a. Written Reports. Written reports are prepared in narrative/essay style or checklist format. A standard terminology for describing the condition of objects is helpful. Frequently used terms are defined in the NPS Museum Handbook, Part II.

    b. Photographs. Standard treatment documentation includes detailed photographs depicting the object's problems and the treatment steps being undertaken. A complete series includes photographs taken before, during, and after treatment. In many cases an important part of photographic documentation is the depiction of the "actual state" of the object, after old restoration and extraneous material has been removed, but before any new restoration.

Long-term preservation of documentation photographs must be a consideration. Color slides are often used in reports; however, archivally processed black and white prints will last longer.

In addition to normal photographic techniques, the following specialized ones are often used:

- Ultraviolet Light - often makes restored areas more visible.
- Infrared Light - may reveal details under obscuring layers of grime or deteriorated coatings; and improve the legibility of difficult-to-read inscriptions.
- Raking Light - shows surface irregularities by illuminating the surface from an acute angle.
- Reflected Light - shows variations in gloss or texture by recording the reflection of a light source.
- X-Ray Radiography - may reveal hidden features.
- Transmitted Light - shows missing areas in translucent objects.
- Photomicrography - shows details too small to be seen by the naked eye.

c. Drawings and Illustrations. These media are useful for noting changes or significant features not adequately illustrated in photographs alone (e.g., repairs, selvage edges, changes in sewing threads in textile objects).

3. Steps in Documentation. Object conservation treatment documentation includes these steps:

a. The park curatorial staff provides any historical information relevant to treatment or any past record of condition or treatment to the conservator who is examining an object.

b. The conservator prepares an examination report. Figures 8.1a-b show a sample examination report. This report includes:

1) A description of the materials, structure, and method of fabrication of the object.

2) An analysis of materials, when appropriate.

3) A description of the condition of the object based on observed chemical, physical, or biological deterioration, including previous repairs or alterations.

4) Deductions, interpretations, or comments.

c. The conservator prepares a treatment proposal. Figures 8.2a-b show a sample treatment proposal. This document outlines the proposed treatment, including alternatives, if any. Enumeration of all technical details usually is not necessary at this stage. It should reflect the problems identified in the examination report, and include time/expense estimates. The park curator reviews the treatment proposal and approves it with the concurrence of the Park Superintendent.

   Note: As the proposed treatment proceeds, the conservator should discuss with the curator any significant departures from what was initially proposed and approved.

d. The conservator prepares a treatment report. Figures 8.3a-b show a sample treatment report. This report describes the procedures followed, the materials used and the method and extent of stabilization/restoration. Photographs and illustrations should supplement the written report, as necessary. Recommendations for subsequent preventive care may be included.

4. Ongoing Documentation by Curators

The curator is responsible for keeping a record of the housekeeping performed on objects. The record should include the method and frequency of cleaning, dusting, waxing, maintaining proper fluid levels for wet specimens, and a listing of all materials used in these operations. This record, along with any other pertinent information, should be made available to the conservator if conservation treatment should become necessary.

The curator is responsible for recording any observations concerning changes in the condition of an object in the collection. These observations should be dated and filed with other documentation on the object in the Accession File or Catalog Folder.

OBJECT EXAMINATION REPORT

OBJECT: Leather Carrying Case   OWNER: National Park Service

CATALOG NUMBER: WAS01

MEASUREMENTS: 20" deep; 26" wide; 45" long

DESCRIPTION:

1. Materials: Brown leather (cowhide); linen fabric lining; iron buckles; linen stitching thread; painted inscription "1775."

2. Manufacture: Leather was vegetable tanned; natural, unbleached linen, plain weave, hand loomed; buckles are hand forged; case is handstitched with heavy linen thread (4 ply, double strand); white lead (?) pigment applied in script to the case cover after the historic period.

CONDITION:

1. Leather

   a. Chemical Stability: Weakened overall condition due to oxidation of collagen fibers; powdering and lack of cohesion of leather due to sulfuric acid decay from contaminants in manufacture and exposure to air pollutants; embrittlement due to detanning of leather from water contact, loss of volatile oils; heavy discoloration of leather due to sulfuric acid decay, loss of surface, exposure to airborne dirt and human contact soils.

   b. Physical Stability: Severe deformity of case due to heavy use, collapsed and unsupported while in storage, shrinkage and stiffening of leather and mechanical tearing and dislocation of sections. Considerable loss of leather (5%) from perhaps souvenir hunters (on rear panel near right end), losses near tears, crumbling of acid decayed areas, and a tremendous loss of surface due to abrasion, cracking and spalling of leather finish; numerous small and large tears and missing elements due to general deterioration and improper handling.

2. Linen Fabric

   a. Chemical Stability: The fabric is weakened from oxidation and depolymerization. Staining of the fibers with numerous inorganic and organic soils has not only caused weakening but disintegration where stains were metallic in nature.

Figure 8.1a. Sample Conservator's Examination Report

b. <u>Physical Stability</u>: The fabric has been mechanically stressed in the same areas as the leather and has been torn accordingly. Lack of stitching has loosened the fabric at the case's seams.

3. <u>Metal Buckles</u>

a. <u>Chemical Stability</u>: Corrosion products are being actively produced. Contact with the leather does not appear to have stimulated deterioration.

b. <u>Physical Stability</u>: Three buckles are missing. Some of the center prongs are bent.

4. <u>Linen Thread</u>

a. <u>Chemical Stability</u>: Threads are oxidized. Oils from the leather have softened linen.

b. <u>Physical Stability</u>: Numerous areas are seriously abraded. Stressing of stitching along tears has broken threads. Stitching has become missing (attaching case top) and some new repair stitches have been added.

5. <u>Painted Inscription</u>

a. <u>Chemical Stability</u>: Pigment binder appears to have sufficient adhesion. Staining of the paint inhibits reading.

b. <u>Physical Stability</u>: Surface of leather is badly cracked and losses have removed paint. Surface soil accumulations discolor and inhibit reading.

<u>CONSERVATOR(S)</u>: <u>DATE</u>:

Figure 8.1b. Sample Conservator's Examination Report (continued)

OBJECT TREATMENT PROPOSAL

<u>OBJECT</u>: Leather Carrying Case   <u>OWNER</u>: National Park Service

<u>CATALOG NUMBER</u>: WAS01

NOTE: Reference Examination Report prepared on 6/26/88

1. <u>Leather</u>

   a. Cleaning: Mechanical cleaning will be accomplished by brushing, vacuuming, and compressed air. Chemical cleaning will be accomplished by local solvent cleaning of soluble soils and stains.

   b. Correction of Deformity: Humidification will be used to relax stiffened, distorted leather. Alignment of case will be accomplished by blocking.

   c. Mending of Tears: Torn areas will be joined and stabilized (stitched or adhered by a backing material). Tears with missing material will be infilled with an aesthetically and structurally compatible material. Loose straps will be reapplied, but missing elements will not be reproduced.

   d. Consolidation: Impregnate areas of leather where acid decay and surface spalling is advanced with a non-detectable synthetic resin.

2. <u>Linen Fabric</u>

   a. Cleaning: Mechanical cleaning by vacuum; wet cleaning with deionized water.

   b. Mending of Tears: Torn areas will be mended by stitching with cotton thread. Backing will be applied to those areas considered to be unstable.

3. <u>Iron Buckles</u>

   a. Cleaning: All corrosion products will be removed mechanically. Buckles will be degreased.

   b. Protective Coating: A barrier coating of synthetic resin will be applied to surface.

4. <u>Painted Inscription</u>

   a. Cleaning: Cleaning of the surface will be accomplished by chemical process.

Figure 8.2a. Sample Conservator's Treatment Proposal

b. Protective Coating: A protective varnish will be applied over the writing.

5. <u>Linen Stitching</u>

   Stitching will be secured where severed by tying off ends. Those areas that are unstable will be restitched with distinguishable linen thread. Recent repair stitches will be removed.

6. The carrying case will be prepared with a custom fit support to protect it while on exhibit and during transport.

7. Photographic documentation of before and after treatment condition will be provided.

<u>COST OF TREATMENT</u>:

Prepared by:____Date:________________
Conservator

Approved by:____Date:________________
Curator

Concurred by:____Date:________________
Superintendent

Figure 8.2b. Sample Conservator's Treatment Proposal (continued)

OBJECT TREATMENT REPORT

OBJECT: Leather Carrying Case OWNER: National Park Service

CATALOG NUMBER: WAS01

The conservation treatment of the leather carrying case was influenced by the fact that it is a highly significant historic object and that its immediate use is for a park exhibit. A conservative approach was employed for its treatment. The treatment did not include restoration.

1. Leather

    a. Cleaning: Overall mechanical cleaning which included brushing and vacuuming; solvent cleaning of all soiled areas with trichloroethane 1.1.1.

    b. Correction of Deformity: Relaxation of the stiffened distorted leather through local and general humidification; blocking and realignment of the deformity with weights and Plexiglas® forms.

    c. Mending of Tears: Torn areas which seriously weakened the integrity of the bag were mended by application of backing supports (dyed calf skin-vegetable tanned) and polyvinyl acetate emulsion adhesive (R2258 by Talas); loose straps were reapplied using the same adhesive and backings were added where necessary; areas of leather loss and missing straps were not restored.

    d. Consolidation: The weakened leather was not impregnated with resin with the exception of the severly weakened straps (15% methyl-methacrylate - Pliantex in trichloroethane 1.1.1 was used).

    e. Lubrication: A light spray coating of synthetic oil was applied to the leather surface to unify surface color (Bavon ASAK ABP) 40% in isopropyl alcohol and water).

2. Linen Fabric

    a. Cleaning: Overall mechanical cleaning was accomplished by vacuuming. Various organic solvents were used to reduce and remove local stains.

    b. Mending: The weakened and torn fabric was not backed and mended. The unattached back edge of the bag's flap was tacked through the original holes with a lashing stitch using dyed linen thread (simular stitches were used in the past which can be evidenced).

Figure 8.3a. Sample Conservator's Treatment Report

3. Iron Buckles

a. Cleaning: All active corrosion products were removed mechanically with scalpel and 0000 steel wool. The metal was degreased with Stoddard's solvent.

b. Coating: All metal buckles received a protective coating of microcrystalline wax (B Square 190).

4. Painted Inscription

Photography: The painted inscription of the flap was photographed to decipher its content using infrared and ultraviolet photographic techniques. (A set of these photographs is included with this report.) The white letters were cleaned using a .1% ammonium hydroxide solution in alcohol.

5. Linen Stitching

Modern repairs were removed with the stitching.

6. Inner Support

An inner support was made for both flap and bag. (The flap was not reattached). The supports were fabricated from polyethylene foam covered with 100% hand loomed linen fabric. The bag was held to its support with fifteen stainless steel 2" pins. The heads were painted brown and they were inserted through stitch holes in the leather.

PHOTOGRAPHS INCLUDED WITH THIS REPORT

Before:	x Polaroid 35 Infrared
During:	x 35 mm slides
After:	x 35 mm slides

Conservator(s) who performed treatment:

Date(s) of treatment:

Cost of treatment:

Figure 8.3b. Sample Conservator's Treatment Report (continued)

D. OBTAINING THE SERVICES OF A CONSERVATOR

1. General Considerations

Whether treatment is performed by an NPS conservator or a non-NPS conservator, the park staff must consider the following factors:

a. The ultimate responsibility for the care of each object rests with the Park Superintendent. No park can or should surrender its authority to make decisions that concern the treatment of its objects. The park, in consultation with the Regional Curator, must review treatment proposals before any work begins. During treatment any deviations from proposals must also be reviewed by park staff.

b. Except for emergency situations, conservation treatment for objects in a collection must be planned. A long-term program for the treatment of objects should be based on a Collection Condition Survey. See Chapter 3 for guidance on this survey.

c. There is an inherent risk in conservation treatment. No conservator will or can guarantee the final outcome.

d. All professional actions of a conservator must be governed by total respect for the physical, historic, and esthetic integrity of an object. As stated in the Code of Ethics and Standards of Practice (AIC), conservators have special responsibilities to objects.

   1) Suitability of Treatment. The conservator should not perform or recommend any treatment which is not appropriate to the preservation of the object. Regardless of the object's value or quality, the conservator should adhere to the highest and most exacting standard of treatment.

   Techniques and materials that affect the objects least and that can most easily and completely be reversed always should be selected. An improvement in conditions of display, storage or use may often be preferable to physical intervention. Nothing should be removed from an object without sufficient evidence that it is not original to the object or important to its history.

   Restoration should be the minimum necessary. It is unethical to modify or conceal the true nature of an object through restoration. The presence and extent of restoration must be detectable, though it need not be conspicuous. All restoration must be fully documented.

   2) Examination and Records. Before carrying out any treatment, the conservator should first make an adequate examination of the object and all available documentation in order to record its condition and history, and to establish the causes of its

deterioration. A record of treatment methods and materials used should be kept as a permanent, accessible archive.

3) Recognition of Limitations. Conservation and investigation should be undertaken only within the limits of the conservator's professional competence and facilities. Moreover, it is the responsibility of the conservator to keep up with current knowledge and to continue to develop skills so as to give the best treatment available.

4) Disclosure of Knowledge. There should be no secrecy about any technique or materials used in conservation. The development of a new method of treatment or a new material, and the composition and properties of all materials and techniques employed, should be fully disclosed as far as they are known. The originator is expected to cooperate with other conservators and conservation scientists employing or evaluating the proposed methods or materials.

5) Post-Treatment Care. It is the duty of the conservator at all appropriate times to volunteer advice to the owner on the subsequent care of a conserved object with regard to its handling and conditions of storage and display.

6) Delegating and Subcontracting. If the conservator delegates work on objects, he or she is directly responsible for the work. This includes work delegated to trainees, volunteers, subordinates or outside agencies. Work should not be delegated or subcontracted unless the conservator can directly oversee the work, or has sufficient knowledge of the agent.

d. In most circumstances, conservators are not curators or appraisers and should not be asked to perform those functions.

e. Mutual understanding and respect for the responsibilities and expertise of park managers, park curatorial staff, regional curators, and conservators are essential to a successful contractual relationship.

f. The Service's conservation treatment philosophy should be communicated to conservators: **NPS policy places emphasis on preserving whatever still exists of an object as nearly as possible in an unchanging, stabilized state.**

g. The type and quality of conservation treatment an object receives is critical. Be prepared to take time to locate conservators and to select a well-qualified conservator.

2. Locating and Selecting a Conservator

National Park Service conservators are available to assist regional offices and parks with conducting Collection Condition Surveys, performing object treatments, and providing technical assistance and

training on preventive conservation measures. The Division of Conservation, Harpers Ferry Center, has a staff of conservators who specialize in the treatment of several types of objects.

The regional offices may have staff conservators who are assigned to a center or a specific park. Outside the Service, there are many regional conservation centers and private conservators whose services may be obtained by contract. Contact the Regional Curator for assistance in locating a conservator.

Since circumstances will vary with each project, park curatorial staffs, regional curators, and superintendents must take into account the following factors in the process of locating and selecting conservators.

a. Appropriateness of particular individuals or laboratories

   1. The conservator should have knowledge and experience in treating the kinds of objects requiring treatment and in using specialized techniques and equipment when needed.

   2. Some treatments may require facilities or equipment beyond those available in some labs.

   3. Objects sometimes need treatment by two or more specialists. To limit handling and shipping of objects it is best then to arrange for treatment at a lab where the required specialists can work together, rather than moving an object to several conservators in different locations with the attendant risk of damage in transit.

b. Transportability of the object

   1) Some objects are too big or too fragile to be moved; therefore, treatment must be on site.

   2) Other objects may be transportable, but reasons of economy or convenience may dictate no travel or travel only to nearby locations. Park staffs may wish, for example, to have significant or valuable objects treated on site or nearby.

   3) Some objects should not travel outside the climatic region to which they have adapted. For example, some furniture from an arid region may be best treated in the same area, rather than being shipped to a more humid zone for treatment, then back to the dry conditions.

c. Curator-Conservator dialogue

   All treatments may require much discussion between curator and conservator in establishing treatment goals and throughout the process when decisions need to be made on the nature and extent of treatment. For example, the curator may need to discuss the

work at several intermediate stages and give approval of results before the conservator proceeds to the next phase of the treatment. Convenience and economy may dictate that the work be done on site or in a lab nearby, to facilitate this dialogue.

d. Geography

Parks are often at some distance from the location of practicing conservators. Even NPS conservators may be at a distance from where their services are needed. Parks may then need to program money in advance for conservators to travel to the site for packing and shipping objects.

3. <u>Steps in Obtaining Services of a Conservator</u>

Step 1

<u>Contact the Regional Curator to discuss the project</u>. Describe the nature of the project (e.g., request for a Collection Condition Survey, treatment of an object or group of objects), the nature (type of material and condition) of the object, the present use of the object, and the planned use of the object (e.g., new exhibit, study collection, storage). The Regional Curator can help in locating possible conservators to perform the work, in securing funding for the project, in setting priorities to determine a time frame for completing the work, and in preparing procurement documents.

Step 2

Select a conservator. If it is determined that the treatment is to be performed by an NPS conservator in the Division of Conservation, HFC, or on the staff of a regional office or collections center, proceed to Step 2A. If the treatment is to be performed by a non-NPS conservator, proceed to Step 2B.

Step 2A (Treatments performed by NPS Conservators)

For work to be performed by the Division of Conservation, HFC, submit an Object Treatment Request (OTR) Form 10-252 (Revised 7/86) to the Regional Curator. This form is used to provide information about an object to be examined and treated by a conservator. Generally, each object requires a separate OTR Form, because the information pertaining to each object is different. Request a supply of the Object Treatment Request Form 10-252 (Revised 7/86) from the Division of Conservation, HFC.

Instructions for completing the Object Treatment Request Form are as follows:

1. Complete and route this form (all four copies) through the Regional Curator to the Division of Conservation, Harpers Ferry Center. The OTR form is to be completed at the park by the person who has curatorial responsibility for the object(s)

in question. If approved, the Division of Conservation sends a copy of the approved OTR back to park.

If the object is not owned by the NPS, written authorization is required for treatment. The treatment proposal must be submitted to the lender for review and approval. In some cases, a lender (or lending institution) may delegate broad authority for treatment to the NPS or a specific park. In those instances, the superintendent or museum curator responsible for the object may sign the OTR on behalf of the lender in the space reserved for the lender's signature, but a copy of the delegation authority must be attached to the OTR.

2. Describe the special importance of each object. The "special importance" of an object is the basis for setting treatment priorities and may help determine what treatment is appropriate. One criterion is whether an object is exhibited. Associative value is another factor. In some instances, high value may be a consideration, apart from any connection with park interpretive themes. The partially completed Form 10-252 in Figure 8.4 shows suggested wording for a properly completed form.

3. Submit a photograph of the object with this request, unless the conservator or Regional Curator is already familiar with the object. A photograph shows the condition(s) necessitating conservation treatment (e.g., tears or broken parts).

4. The Regional Curator reviews and signs the Form 10-252 and forwards it to the Division of Conservation, HFC.

5. If the object treatment is approved to be performed by a conservator in the Division of Conservation, HFC, contact the Registrar, Division of Conservation for the schedule and specific procedures for sending the object(s).

6. Treatment of objects is completed and objects are returned to the park. When objects are returned, notify the Regional Curator. File the Treatment Report, photographs, and associated documentation in the Accession File or Catalog Folder.

   Note: For work to be performed by an NPS Conservator in a regional office or collections center, contact the Regional Curator for instructions on documenting the request and on scheduling and shipping of objects requiring treatment.

Step 2B (Treatments performed by Non-NPS conservators)

1. Contact the Regional Curator for instructions on documenting the request for object treatments.

2. Contact the Regional Curator for assistance in locating non-NPS conservators with the required specialties (e.g., paintings, paper, photographs, books, textiles, objects, ethnographic and archeological materials, natural history specimens, furniture, frame conservation). The Regional Curator and the Regional Contracting Officer should maintain an open list of conservators (e.g., private, regional/university laboratories, companies) and their specialties. Each region should establish this list by advertising in the Commerce Business Daily and in the American Institute for Conservation (AIC) Newsletter for conservators who desire to provide conservation treatment services to parks. This list should periodically be updated. The Division of Conservation, HFC, also maintains a list of conservators.

3. Prepare the procurement plan or strategy for the work to be performed. Refer to Section E of this chapter for guidance.

Step 3

Contact the selected conservator for instructions on scheduling the work and on shipping objects to be treated.

Step 4

Review all condition reports and treatment proposals. Discuss any questions with the conservator. Before work begins on an object, the curator or the person with delegated responsibility must approve and sign a treatment proposal. The park may prefer to have the advice and concurrence of the Regional Curator in reviewing treatment proposals. File a copy of signed treatment proposal in the appropriate Accession File or Catalog Folder.

Step 5

During this step, the work is completed. Monitor progress of work by visiting the conservation laboratory or by telephone conversation discussions with the conservator.

Step 6

Treatment of objects is completed and objects are returned to the park. Before payment is approved for contract conservators, park staff must ensure that all conditions of the procurement contract or agreement have been satisfactorily completed. When objects are returned, notify the Regional Curator. File the Treatment Report, photographs, and associated documentation in the Accession File or Catalog Folder.

HFC ACCESSION NO.

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
OBJECT TREATMENT REQUEST
DIVISION OF CONSERVATION
HARPERS FERRY CENTER
HARPERS FERRY, WV 25425

FOR REGION USE

To be completed by Park:

PARK: Cumberland Island National Seashore DATE OF REQUEST: ________

OBJECT: Oil Portrait (Margaret Carnegie) w/o Frame

Is object owned by NPS? Yes [X] No [ ] CATALOG NO.: CUIS 1644

If no, proposal for treatment must be reviewed and approved by the lender. Before treatment can begin, written authorization by lender is required.

Signature: ________ Date: ________

Briefly describe condition(s) necessitating conservation treatment:

TREAT FOR EXHIBIT [X] STORAGE [ ]

Paint loose on portrait surface; some paint has been lost; canvas sagging and loose around edge of stretcher.

What is the special importance of this object?

Portrait of Thomas & Andrew Carnegie's Mother, to be hung in restored historic room exhibit at the Plum Orchard Mansion.

Requested date of completion and reason: July 1987; Date Exhibit is to be installed.

Person at park to contact concerning this request:

Name: ________ Title: ________ Phone No.: ________

ATTACH COPY OF CATALOG CARD AND CURRENT PHOTOGRAPH OF OBJECT

To be completed by Regional Curator:

Comments: ________

Signature: ________ Date: ________

For Conservation Lab Use Only:

Date OTR Received: ________

Date Received: ________ Location: ________

Form 10-252
Rev. 7/86

Figure 8.4. Example Object Treatment Request (OTR), Form 10-252

E. CONTRACTING FOR CONSERVATION SERVICES

1. Introduction

Contracting for services is governed by the Federal Acquisition Regulation (FAR) and the Department of the Interior Acquisition Regulation (DIAR). National Park Service policy and procedural guidance for acquisition of products and services is provided in NPS-62, Acquisition Guideline. NPS-28, Cultural Resources Management Guideline, Technical Supplement provides guidance on procuring needed professional services for managing cultural resources. The National Park Service can enter into cooperative agreements under the provisions of P. L. 95-224, the Federal Grant and Cooperative Agreement Act of 1977. NPS-20, Federal Assistance and Interagency Agreements provides guidance on cooperative agreements.

Important participants in the contracting process are the Contracting Officer (CO), and the Contracting Officer's Technical Representative (COTR). The CO is delegated actual authority by the government to enter into and administer contracts (e.g., to commit the Federal government to pay for products and services). Responsibilities of NPS contracting officers are as follows:

a. Determining the type of contract for a given project.

b. Negotiating contract terms and prices.

c. Ensuring that the entire transaction is documented.

d. Exercising sole authority for negotiating any changes in terms, conditions or amounts cited in a contract.

The Contracting Officer can make informed decisions about conservation services if given adequate information about the nature of the work by the curator or the conservator most directly involved in the work.

The Contracting Officer's Technical Representative is a federal employee who provides advice on the technical aspects of the work being contracted. The COTR for a conservation contract can be an NPS conservator with the appropriate specialty, the Regional Curator or the park curator who is knowledgeable about the object's use and conservation needs. The responsibilities of this person are as follows:

a. Monitors the contractor's technical progress, including the surveillance and assessment of performance and recommends to the Contracting Officer changes in requirements.

b. Interprets the scope of work.

c. Performs technical evaluation as required.

d. Performs technical inspection and acceptance required by the contract.

e. Assists the contractor in the resolution of technical problems encountered during performance, through technical direction.

Contracts for purchases and services that exceed $2,500 must be awarded on a competitive basis. Formal Advertising (called "Sealed Bidding" after April 1, 1985) is a procurement method whereby the Federal government solicits bids from qualified sources for services or products that are precisely described in the solicitation. Since the government has precisely stated the requirements of the work to be performed, price and factors affecting price become the sole determining factor in contract award. Under a formally advertised contract, solicitation is done with an Invitation for Bids (IFB). This method is not a suitable method for procuring professional conservation services because of the impossibility of drafting precise specifications for the work. Such exact specifications cannot be written into a conservation contract because of hidden conditions in object treatment, the need for detailed examination of each object before treatment, and the need for flexibility and dialogue with the contracting conservator.

NOTE: There may be more than one valid approach to treatment of an object, and competent practitioners may disagree, sometimes strongly. This means that bidding on another conservator's examination and recommendations may lead to problems, once the contract is awarded and the contractor has had a chance to examine the object firthand.

2. Types of Procurements for Conservation

a. Purchase Order. This method is suitable for procuring conservation services that do not exceed $2,500 (e.g., treatment of a single object, analytical testing of materials of an object, a Collection Condition Survey for a small collection). Although this method need not be awarded on a competitive basis, the park staff should insure that the provisions of a negotiated contract are applied to the selection of a conservator and that a fair and reasonable price is obtained. Once a conservator is selected, park staff should request a treatment proposal. Prepare a Requisition Form DI-1. Use the conservator's treatment proposal to describe the requested service. Insure that the agreement requires a treatment report for each object.

b. Procurement by Negotiation. Negotiated contracts (called "Competitive Proposals" after April 1, 1985) differs from formal advertising in two key respects: negotiated procurements allow flexibility and change in the offer through discussions, and may lead to awards based on factors other than, or in addition to, price. For larger projects (e.g., exceeding $2,500), a negotiated contract allows several conservators to examine the object(s) in question and submit their own recommended treatment proposals.

Evaluation can be made on the basis of qualifications and experience of the offeror and appropriateness of the proposal, and not merely on the cost.

Under a negotiated contract, solicitation is done with a Request for Proposals (RFP) or a Request for Quotations (RFQ). The solicitation document advises prospective contractors of the details and specifics of the government's requirements. The contracting officer is responsible for the preparation of solicitation. It must contain all of the terms and conditions intended for the final contract, provide sufficient information for competing concerns to respond on an equally informed basis, and provide evaluation and award criteria. A significant portion (Scope of Work, evaluation criteria) of the solicitation will be based on data provided on the procurement request prepared by the program office (e.g., park curatorial staff, NPS conservators, Regional Curator).

c. Indefinite-quantity contracts. This method may be useful in the future for parks or regions with large collections of artifacts needing treatment. This form of contracting would also be effective in obtaining emergency treatment of objects damaged by vandalism, water, or fire. The Contracting Officer can issue Task Orders under an indefinite-quantity contract. Most indefinite quantity contracts cover a one year period with renewal options for continued performance. The contract is administered by the guaranteed minimum and maximum workloads in each contract. Frequently this is the current fiscal year. Delivery orders can be issued as the need in the park arises. This is especially efficient when there are quantities of minor treatments to be performed and the extent of repair is negotiable. The curator and conservator can work out a level of treatment that is deemed appropriate to the suitation. The conservator then submits a proposal for treatment for approval by the curator. Such an indefinite quantity contract would be especially advantageous to the government in dealing with a regional conservation center so that parks can take advantage of many different experts to solve a variety of problems under one contract. The indefinite-quantity contract is a negotiated contract that is awarded on a competitive basis. These contracts are awarded for multiple jobs, or an indefinite quantity of work, established between minimum and maximum dollar amounts. General specifications and quality standards govern the life of the contracts while detailed specifications vary from job to job. Once established, work is performed when necessary by placing task orders with the contractor. The cost of each task is negotiated.

d. Cooperative Agreement. The principal characteristic of this instrument is that the Federal government is both a financial supporter and participant with another entity in joint pursuit of a public objective. A cooperative agreement is not to be used in place of a contract. It is only used in those situations where

there is a definite cooperation of assistance between the Service and the other party.

Cooperative agreements can be used to obligate funds to qualified recipients, over a period of up to five years (renewable; subject to availability of funds each fiscal year), to provide assistance in which Service representatives will have frequent and significant involvement. The cooperative agreement also assures the availability of a specific professional service for more than one year, without having to advertise each specific task the cooperative party may be called upon to do. The aid of a cooperator could be obtained to complete a multi-year program of treating several types of objects in a park's collection.

An example of a cooperative agreement involving conservation services is an NPS region cooperating with a local university conservation laboratory or a regional conservation laboratory to provide conservation training on the object care with the significant involvement of NPS curators and possibly conservators.

3. Procurement of Conservation Services Exceeding $2,500

The following two-phase negotiating contract procedure is recommended for planned conservation projects that exceed $2,500. These procedures are established to accomplish the following goals:

- Ensure that competition is fair and objective.
- Ensure that each project is open to as many qualified conservators as possible.
- Encourage an active role by the park curatorial staff in the contracting process.
- Ensure that each object receives appropriate treatment by a qualified practitioner.
- Allow for the conservator who provides the examination report and treatment proposal to perform the treatment.
- Allow the conservator to receive payment for the work performed in Phase I prior to beginning work on actual treatment.

a. **Phase I - Selection of a Conservator for Project**

The first phase includes the following four steps:

1) Step I - Request for Proposal

Send a Request for Proposal (RFP) to conservators in the desired specialty who have expressed a desire to provide conservation services. The Request for Proposal should include

a brief description of the park, the park's collection, and of the immediate conservation project.

2) Step II - Scope of Work

Prepare a Scope of Work Statement that includes a description of the conservation treatment required and the desired qualifying specifications. Qualifying specifications include the reason for treatment (e.g., storage, exhibit, travelling exhibit), desired result of the treatment, insurance coverage for object(s), and facility security. The scope of work includes completion dates; the stated requirement that all work must be carried out in accordance with the Code of Ethics and Standards of Practice of the American Institute for Conservation (AIC); and the stated requirement that full treatment reports with accompanying photographs must be provided upon completion of the work.

3) Step III - Content of Each Conservator's Proposal

This proposal is not a detailed condition report or treatment proposal, since at this point the conservator has not examined the object. However, the conservator should include the following information in the proposal:

a) A current resume that indicates education and experience in conservation treatment and provides references. This part of the proposal must include resumes of all persons who will assist in this project.

b) Description of approach to the general treatment process for each object type. This description must be relevant to the requested project and must include commonly used methods, techniques, materials, and expected results.

c) Evidence of past experience in comparable areas of treatment (e.g., sample treatment reports/photographs) appropriate to work described in the Scope of Work.

d) Statement indicating technical capacity to accomplish the work required (e.g., facilities, equipment) and of ability to meet required dates of completion.

e) Statement describing proposed methods of transportation (e.g., methods of packing and shipping), security of facility where work will be accomplished, and insurance coverage. This proposal does not require a Condition/ Treatment Proposal for each object described in the project's Scope of Work.

4) Step IV - Evaluation of Proposals

Technical proposals are submitted to the park's or region's Contracting Officer. A technical evaluation panel assists the Contracting Officer with evaluating each proposal. The professional panel must be composed of individuals related to the museum profession (e.g., regional curator, park museum curator, NPS conservator). Because many parks do not have a park curator, the Regional Curator may assist parks with the evaluation step. Each proposal is reviewed and evaluated based on pre-determined weighed factors assigned to criteria (e.g., training and work experience, treatment of comparable objects, appropriateness of method, ability to meet special requirements, and level of effort) for each technical proposal.

Total scores for each proposal evaluated are collected by the Contracting Officer at the beginning of the review meeting, followed by discussions of each proposal by the technical evaluation panel in terms of the stated evaluation criteria. When each proposal has been thoroughly discussed, each panel member finalizes their individual evaluation opinions and ratings, and makes a determination as to the acceptability or unacceptability of each proposal. To the extent possible, the panel shall work towards a consensus of acceptability or unacceptability of each proposal. Concrete technical reasons based on the actual evaluation criteria must be provided to support all determinations of unacceptability. Negotiations will be held with all offerors in the competitive range. The technical evaluation panel will re-evaluate best and final offers recommending award of a contract(s) to the Contracting Officer. If no proposals are determined acceptable by the Contracting Officer, Phase I of this process ends with no contract being awarded.

At this point a contract may be awarded to the conservator or conservation organization with the most appropriate proposal. Price will be a factor in the award decision, although the award may not necessarily be made to the offeror who submits the lowest price or labor rates.

b. **Phase II - Awarding the Contract**

The second phase includes the following three steps:

1) Step I - Obtaining Detailed Condition Report/Treatment Proposal

Award a contract for a detailed Examination Report and Treatment Proposal for each object, or group of objects, to receive treatment under the contract. This step will require the conservator to examine all of the objects. In most instances, the objects will need to be transported to the conservator's laboratory. Therefore, negotiations for this

step should include transportation costs and the cost of special handling and/or certified mail. Proposal should provide a firm cost for all treatment work.

The submitted Condition Report and Treatment Report are reviewed and approved by the COTR for the project. The COTR may consult NPS conservators about the proposal. Whether the proposals are accepted or not, the conservator receives payment for the services rendered in completing Step I.

2) <u>Step II - Treatment of Object(s)</u>

If approved, the contract is awarded to the conservator in accordance with the approved Treatment Proposal. Depending on the nature and difficulty of treatment, the COTR and conservator should schedule periodic conversations about the treatment process. No changes in treatment are to be made by the conservator without approval in writing of the COTR through the CO.

3) <u>Step III - Completion of Contract</u>

Upon final completion and acceptance and return of all objects to the park and receipt of the required documentation (reports and photography), full and final payment will be authorized.

F. EMERGENCY CONSERVATION TREATMENT AND HANDLING

A minority of emergencies involving museum collections will require immediate actions by a park's curatorial staff. During these incidents a calm and well prepared staff will prove most effective. Deterioration of any specific material generally will not proceed so rapidly that consultation and perhaps even direct assistance cannot be obtained from the appropriate resources. Depending on the category of emergency all staff should have considered what, as well as who, are their principle resources. Planning should include considerations for flooding, fire, theft, vandalism, infestation, earthquake, and accidental damage. Refer to Chapter 10 of this handbook for guidance on emergency planning.

Because each emergency situation will differ in nature and degree, it is impossible to offer complete guidelines for emergency object treatment. Advice can be given here, however, which will place most objects beyond immediate danger and allow more time for staff to obtain professional advice, and for help to be secured. Therefore, these guidelines are limited to those actions that park staff may need to take immediately for objects damaged by the following causes:

- Wetting/water saturation
- Accidental breakage/disfigurement
- Staining/soiling
- Biological Infestation

1. General Guidelines

Initial steps for all categories of emergencies are as follows:

a. **Notify the Regional Curator. Seek a conservator's advice or assistance as soon as possible.**

b. First take the time to assess the situation: review pre-disaster plans and these guidelines.

c. Sort objects in terms of curatorial priority and susceptibility to further damage in the circumstances of this incident: attend to important susceptible objects first. This priority setting should be identified in the park's Emergency Operations Plan (EOP).

d. If objects must be moved, first locate a safe place to put them where they will not be subject to further disaster damage, and where security and environmental conditions are adequate. Such spaces should be identified in the park's Emergency Operations Plan.

e. Staff members who move museum objects should know about their fragility and special needs. Identify these people ahead of time; train them if necessary; keep their phone numbers current and accessible.

f. Keep identification with each object, especially catalog numbers.

g. Keep fragments in association with the parent object.

2. <u>Wetting/Water Saturation</u>

a. Water related damage may include:

1) Mold and mildew formation. This is particularly likely in warm, moist conditions (above 65% RH and 70°F); and can result in staining and weakening of organic materials like paper, leather, textiles, wood, and painted surfaces.

2) Dimensional changes such as swelling and shrinkage which can result in warping, curling, splitting, cracking, and overall deformity.

3) Coating and adhesive failure in which protective coatings, varnishes, paint, and adhesives can soften, swell, loosen, blanch, buckle, and flake.

4) Staining and soiling. Contaminated water can carry mud, oil, etc. Corroding metals and dyed materials can stain adjacent materials.

5) Corrosion of metals. Ferrous alloys are most immediately affected.

b. General guidelines for reduction or prevention of water damage

1) Sort affected objects according to curatorial priority and susceptibility to water or moisture damage.

2) Attend to organic materials first as they are more quickly damaged by water or mold.

3) To retard mold development, vulnerable objects can be put into cold storage. The colder the better, but keep the temperature above freezing, except books and paper which may be frozen.

4) Avoid freezing objects without specific recommendations from a conservator. Objects, except books and paper, could be damaged in the process of freezing.

5) Do not attempt to remove mud from wet fragile objects with stiff tools or knives. Organic materials are very delicate when wet and can be easily torn or distorted. Never use hot water. If the object is strong enough, use a soft bristle brush to gently remove mud.

6) If possible, keep wet artifacts away from dry ones.

7) Effective air drying requires a low relative humidity (below 50% RH), moderate temperatures (65-75°) and constant air circulation.

3. Accidental Breakage and Disfigurement

Time is not normally of the essence when objects break or are crushed or bent. However, when broken parts of objects are in an area subject to foot or wheeled traffic, the following action must be taken immediately:

- Save all the pieces.
- Keep identification with the detached fragments.
- Brittle or fragile fragments should be placed in padded chip-board trays if possible. The padding will prevent the pieces from sliding into each other and causing further chipping. Do not pile fragments together in a bag.
- Do not attempt to fit pieces together on a trial basis. This attempt may cause further damage to delicate edges.
- Do not use tape to hold pieces together.

4. Staining/Soiling

Problems with furnaces sometimes result in a deposit of oily black soot over everything.

- Do not attempt to wipe soot from porous artifacts.
- Minimize handling. If handling is necessary, the use of gloves such as polyethylene or latex surgical gloves can help prevent moisture from the hands driving the soot deeper into the object.

Generally speaking, most applications of graffiti are easier to remove the sooner the problem is attended to. However, because there are so many combinations of defacing materials, substrates, and surface finishes, that it is impossible to provide much useful guidance. Contact the Regional Curator. Obtain a conservator's help immediately.

Similarly, sudden staining of textiles involves so many possible combinations of materials, that it is only prudent to obtain professional help. In some situations, no harm will come from delay. In others, a stain could set and prove difficult or impossible to remove unless treated as soon as possible.

5. Biological Infestation

The most urgent task in preventing further damage to a water affected material is the control of relative humidity to reduce the possibility of biodeterioration. Without such control, micro-organism (e.g., mold and fungi) attack and can quickly be the cause of irreversible damage. The types of mold and fungi that are likely to attack damp or wet museum objects require high humidity (above 70% RH) and high temperature (above 20°C or 68°F) as well as stillness of air and limited lighting. Because a high moisture content is present in the wet object, biodeterioration can progress even when room humidity is low.

- Take immediate action to mop up any standing water.
- Begin monitoring the collection's environment (e.g., relative humidity, temperature).
- Lower the temperature to well below 20°C or 68°F in a room housing water damaged artifacts. Portable air conditioners can be used to lower the temperature. An indirect effect will be the slight lowering of the room's humidity level.
- Use air circulating fans and dehumidifiers to reduce the risk of microorganism attack. Circulating air equalizes the relative humidity of a contained environment and promotes even drying. Use both devices together to ensure that the relative humidity of the room environment falls gradually, because abrupt changes in temperature and relative humidity can cause damage to material that is only slightly damp.
- Keep air conditioners, dehumidifiers, and fans running 24 hours a day.
- Begin monitoring for insect activity. Refer to Chapter 5 for guidance on establishing a pest monitoring program and for action to take when an infestation is discovered.

6. Guidance For Specific Object Types

Guidance for handling and care of specific object types in emergency situations is outlined in the appendices of this handbook.

G. SELECTED BIBLIOGRAPHY

American Institute for Conservation of Historic and Artistic Works.
1985 _Guidelines for Selecting a Conservator_, Washington, D.C.

Barton, John P. and Wellheiser, Johanna G.
1985 _An Ounce of Prevention: A Handbook on Disaster Contingency Planning for Archives, Libraries, and Record Centres_. Toronto Area Archivists Group Education Foundation, Toronto, Canada, pp. 57-79.

Keck, Caroline
1972 "On Conservation: Recognizing Qualified Practitioners," _Museum News_ (February), 50:6:9. Washington, D.C.: American Association of Museums.

Keck, Sheldon (Editor)
1982 _Emergency Care of Museum Artifacts and Library Materials Affected by the Flood_ (looseleaf set of papers). Cooperstown, New York: New York State Historical Association.

Mibach, Lisa and Wolf, Sara J.
1983 "Ethical Considerations in the Conservation of Native American Sacred Objects." _Journal of the American Institute for Conservation_ (Fall), 23:1:1-6. Washington, D.C.: American Institute for Conservation.

Orraca, Jose
1981 "Shopping for a Conservator," _Museum News_ (January/February), 59:4:60-66. Washington, D.C.: American Association of Museums.

Schmidt, J. David
1985 "Freeze-Drying of Historic/Cultural Properties: A Valuable Process in Restoration and Documentation" _Technology and Conservation_ (Spring), pp. 20-26.

Ward, Phillip
1986 _The Nature of Conservation, A Race Against Time_, Chapter 4, "The Training of Conservators," pp. 35-43. Santa Monica, CA: The J. Paul Getty Institute.

CHAPTER 9. MUSEUM COLLECTIONS PROTECTION: SECURITY AND FIRE PROTECTION

A. INTRODUCTION TO MUSEUM COLLECTIONS PROTECTION

Whether museum objects are exhibited in cases or in furnished rooms or whether they are in storage or in transit, their protection against various risks poses unique problems. The general categories of threats to museum collections (e.g., those hazards that can destroy, damage, or cause the loss of museum objects) are fire, theft, vandalism, natural disasters, improper environmental conditions, and careless acts.

In general, museum security is the art of protecting collections, information, equipment, physical facilities, visitors, and staff from any type of harm. The primary objectives of a museum security program are as follows:

- To provide for the protection and safety of staff and visitors.
- To prevent the loss of museum objects from all recognized threats.
- To protect the documentation (e.g., accession records, catalog records, conservation reports, photographs, field data) on the objects in the collection.

Protection of museum collections is basic to the National Park Service's preservation mission and ethic. As stated in Chapter 1, the purpose of any museum is to collect, preserve, and interpret the historic, scientific, artistic, or cultural heritage entrusted to it. Without protection, there can be no preservation or interpretation. Refer to Appendix G for a discussion of laws, regulations, NPS policies and requirements, and other NPS guidelines that relate to the protection of NPS museum collections.

1. Threats to Museum Security

The threats to museum collections can be categorized as crime, civil disturbances and warfare, catastrophic events, and other events. The specific types of threats under each of these categories are described below.

a. Crime

- Burglary: Theft by felonious, surreptitious entry. Burglary usually occurs during non-operating hours. Usually only high value property is stolen, although vandalism also may occur. (Note: Burglary statutes vary from state to state. Some do not cover business establishments, only homes. Some require a nighttime entry.)
- Larceny-Theft: Unlawful taking or stealing of property or articles of value without the use of violence or fraud. Often this crime is committed on the spur of the moment. The property stolen does not always have a high value. There is presumption that the property was not entrusted to the care of

the person committing the theft. Presumption of theft also can be raised by possession of recently stolen property.

- Robbery: Theft by violence or threat of violence to one's person. This crime is not usually a museum security problem although robbery and assault on staff and visitors have occurred. Also included under this heading might be the taking of a hostage in order to force someone on the museum staff to open the building or a secure area within the building.

- Embezzlement: Appropriating fraudulently to one's own use or benefit property entrusted to one's care (the "inside job"). The property stolen might be sold (fenced) or retained for the personal use of the embezzler.

- Arson: The malicious burning of or attempt to burn property. Generally, an entire building will be affected, rather than specific objects or property contained within.

- Bombing: The act is self-defining. It should be noted that there may be only a bomb threat without explosives actually being placed if the intent is only to disrupt normal activities. However, since the intent could be to cause destruction of property or loss of life, it is wise to assume that explosives have been placed.

- Vandalism: Willful or malicious destruction or defacement of objects, exhibits, or structures. This crime may be accompanied by theft and may be random and indiscriminate or directed toward a particular object, building, or exhibit. Vandalism can be called sabotage if committed to hinder operations, especially if it affects national security or defense.

- Shoplifting: The same act as "larceny-theft" defined above, but related to the specialized situation of merchandise for sale being the property stolen. This threat will occur only when there are sales operations within the museum.

b. Civil Disturbances and Warfare

- Civil Disturbances: Disturbance of civil order and the peace. This activity may be organized or spontaneous; may be indiscriminate, involving the museum as a consequence of its location, or discriminate, involving the museum as a planned target; and may be a prelude to other criminal activity, especially vandalism and larceny and possibly robbery and assault.

- Conventional Warfare: Damage or destruction due to the acts of invaders or loss through capture. This activity may include hazards due to disruption of civil order and public utilities and services.

- Nuclear Warfare: All the risks attributable to conventional warfare are present plus the dangers of total destruction through nuclear blast and contamination from radiation.

c. Catastrophic Events

- Natural Catastrophes: Earthquake, volcanic eruption, flood, hurricane, tornado, tidal wave, lightning, and wildfire.

- Industrial Disasters: Explosion, structural collapse, fire, a major accident, nuclear incident, major power outage or utility loss, and serious break in water, sewer, or gas line. All of these events can destroy museum objects and buildings and endanger employees.

d. Other Threats

- Self-Sustained Losses: Damage to objects, exhibits, or structures caused by staff carelessness, inaction, or inattention. This situation may create circumstances leading to larceny-theft or burglary and should be considered totally avoidable. Accidents not due to any willful fault or misconduct of a staff member may not be totally avoidable.

- Acts by Disturbed Persons: While the result of possible acts by disturbed persons may be the same as acts by those acting willfully (e.g., a fire or damage to an object), no criminal intent is present and the person probably could not be held pecuniarily liable for acts. However, a guardian of such a person might be liable for the ward's actions.

- Transportation Accidents: Damage could occur to historic buildings and monuments as a result of a vehicle out of control. More likely, damage could occur to objects being transported in a vehicle (e.g., car, truck, plane) involved in an accident.

2. Protecting Museum Objects

Protecting museum collections housed in park museums, visitor centers, and furnished historic structures is unique. The following factors distinguish museum spaces from other types of premises that require protection:

a. Museums possess objects that are recognized by the public to have value. This value is interpreted as monetary value by a thief or vandal. Many objects have high monetary value because of the materials of which they are made, their association with a famous person or event, their desirability as collectors items, their age, or some combination of these factors.

b. Museums house a concentration of valuable objects. This situation is different from a department store where valuable items may be widely scattered over a large area. This concentration of valuables in one location makes a museum a more desirable target to theft or to loss through fire.

c. A park's museum collection may include unique, irreplaceable objects (e.g., the pistol used to shoot President Lincoln, George Washington's tent, plant type specimens). These objects cannot be replaced if lost.

d. Museum objects must be made accessible for public enjoyment. A museum interprets objects so that they have meaning for the public. Unlike a bank, a museum cannot lock up all its valuables in a vault. During a museum's daily hours, the collection is reasonably accessible to the public in exhibits and through study and research. However, when the museum is closed to the public, the structure housing the collection must become as secure as any bank vault.

e. Visitors to the parks and museums are increasing in number. Among them may be a few persons who may be intent on malicious acts of vandalism or may be looking at the exhibits to detemine what objects may be stolen easily. There is no way to screen visitors to eliminate this threat. Therefore, it is important to take all steps to <u>prevent</u> them from doing any harm to objects.

3. <u>Responsibility</u>

Security is the responsiblity of each park employee, whether permanent or seasonal, salaried or volunteer). Responsibility for protecting the museum collections begins with the park's curatorial staff. However, it is important to keep in mind that protection for museum collections is only a part of the park's overall security program. The primary responsibility for physical security, fire protection, and emergency management is delegated to the park's ranger staff. The park's maintenance staff also plays an important role in the park's security program. Accordingly, the curatorial staff needs to identify security deficiencies in spaces housing museum collections. Work closely with ranger and maintenance staffs, and as appropriate, the Regional Curator, the Regional Security Coordinator, and the Regional Structural Fire Coordinator, in initiating appropriate actions to correct deficiencies. Refer to Appendix G for additional sources of assistance.

Good security depends ultimately on park management's decision on the measures considered to be most effective and on their commitment to allocate staff and funds to implement those measures. Curatorial staff should demonstrate the need for such a committment by creating an awareness and appreciation in all park staff (e.g., superintendent, rangers, maintenance staff, interpreters, scientists, archeologists, historians, administrative staff, and volunteers)

mission. The ethics of the museum profession demand the personal commitment of the curatorial staff to the security of the park's museum collection.

4. <u>Risk Management</u>

Risk management is often associated only with insurance coverage. However, risk management is much more than insurance. It also involves identifying, evaluating, and eliminating as many risks as possible by implementing effective countermeasures. Insurance coverage should be the last element in a risk management program.

The application of risk management techniques is vital to implementing a security program in order to make the program cost-effective. Risk management demands a methodical appraisal of threats followed by the use of the most economical methods for dealing with those risks. <u>First</u> the threats are identified and measured through a security survey. <u>Next</u>, ways of dealing with the threats are considered. Whenever possible, threats should be eliminated. However, some threats cannot be eliminated. When that is the case, consider the possibility of reducing them. This approach is frequently found to be more cost-effective.

When some risks have been eliminated and others reduced, there are two strategies available for coping with the risks that remain: risk assumption and risk transfer.

- <u>Risk Assumption</u> means using existing resources to deal with meeting losses as and when they occur. For example, usually it will be advisable to assume the risk of some forms of vandalism. Replacing a broken window pane is a lot less expensive than hiring additional staff to keep it from being broken.

- <u>Risk Transfer</u> means that a known cost, such as an insurance premium, is substituted for the chance of a greater loss which may arise through risk assumption. Because the Federal Government does not insure its own property, risk transfer is not employed by the Service except in instances where borrowed property belonging to others is insured. See NPS <u>Museum Handbook</u>, Part II, Museum Records, Chapter 4 for guidance on insuring borrowed objects.

B. THE SECURITY SURVEY

The National Institute of Law Enforcement and Criminal Justice describes the security survey as "a critical on-site examination and analysis of an industrial plant, business or home, public or private institution to ascertain the present security status; to identify deficiencies or excesses; to determine the protection needed; and to make recommendation to improve the security."[1] The primary role of a security survey is to assist a park in identifying and removing or reducing crime risks. While fire protection is often considered as a separate function from physical security, it is often more efficient to include fire protection in a security survey. The approaches to response are interrelated. Refer to Section E of this chapter for guidance on conducting a fire prevention survey.

A security survey is an important tool that identifies threats against the park's museum collection. A museum security survey may be conducted as part of a total or partial security survey for a park or as an independent study of only the facilities/spaces housing museum objects. It examines operating procedures and physical measures for collections security and makes recommendations for correcting any deficiencies noted. A survey nearly always results in a Security Survey Report being prepared.

1. <u>Basic Security Inspection</u>

   Curatorial staff can conduct an inspection of the park's museum spaces to identify security deficiencies. There are three steps to this inspection procedure.

   a. Identify Nature of Museum Collection

      Describe and evaluate the nature and value of the museum collection. Include the types of materials in the collections (e.g., paper, stone), the value of objects (e.g., monetary, research, interpretation), and the most significant objects (e.g., letter signed by President Truman). Refer to Chapter 2, Section E for guidance on determining the value of a park's museum collection.

   b. Identify Location of Museum Collection

      Identify the location(s) of the museum collection (e.g., visitor center exhibit, storage), especially the most valuable, attractive, or vulnerable portions of the collection.

   c. Inspection

      Use the NPS "Inspection Checklist for Museum Storage and Exhibit Spaces" included in Appendix F to identify basic deficiencies in museum security and fire protection. Work closely with the park's Physical Security Coordinator and Structural Fire Coordinator, and with the Regional Curator in conducting this basic inspection and for assistance in correcting deficiencies.

The revised Special Directive 80-1 (March 1990) requires that each park facility/space housing museum objects be inspected every three years.

2. Comprehensive Security Survey

The results of the basic security inspection may indicate the need for a more extensive survey or the need for a new intrusion detection system or for the need to rehabilitate the existing system. For example, a park may request that a survey report provide a detailed "Scope of Work" that can be used to procure the needed intrusion alarm system. Appendix G contains a comprehensive checklist that may be used in a detailed security survey of exhibit spaces, storage spaces, and furnished spaces in a historic structure. In most cases, this type of survey will require the assistance of a non-park surveyor. Work with the appropriate park staff and the Regional Curator on programming for this survey. Contact the Regional Curator for assistance in locating a surveyor. The surveyor(s) must demonstrate specific experience in surveying museums and historic sites. They must be aware of the special requirements of museum operations, especially in the context of parks and historic sites. There are four steps to a security survey.

Step 1. Preparing for the Survey

1. Obtain park management's assurances that all areas of the facility will be available to those conducting the survey and that all employees will answer candidly whatever questions may be asked of them.

2. Provide the surveyor or team with a copy of the most recently completed NPS "Inspection Checklist for Museum Storage and Exhibit Spaces" (associated with Special Directive 80-1). Be prepared to discuss the status of this park self-assessment with the surveyor(s). Provide the results of any previous security surveys that have been conducted.

3. Provide the surveyor or team surveyors with copies of large-scale plans of all facilities housing museum collections. The surveyors use these plans to record information observed. The annotated plans should be attached to the completed survey report. Attaching a set of plans will make understanding the report much easier when it refers to such matters as locations for security lighting or doors that require increased surveillance. Provide information on the existing intrusion and fire detection systems and fire suppression systems.

4. During the site visit, be prepared to spend time with the surveyor. Meetings should be scheduled with the surveyor, Superintendent, key park security and fire protection staff, and curatorial staff prior to beginning the survey and at the

conclusion of the survey. At the closeout meeting, the surveyor discusses the findings with the park staff.

Step 2. Risk Analysis

After the survey has been conducted, a risk analysis is performed. This analysis indicates which potential threats or hazards are most likely to happen and which would have the greatest adverse impact on the museum facility and collection. The analysis indicates the probability and criticality of each potential threat so that knowledge is available on which threats will require countering first and which may have to wait until more resources are available. Ordering the priorities in this fashion will make the entire museum security program more cost-effective. Refer to Section C of this chapter for discussion of vulnerability assessment and hazards analysis.

Step 3. Preparation of Security Survey Report

When the survey and the hazards analysis are complete, a survey report is written. This report details the security weaknesses and strengths found and makes recommendations for correcting any deficiencies. The report should present as many alternatives as possible for dealing with particular security deficiencies so that the person responsible for deciding which measures to implement can select the ones that are within budget and are the most practical. For this reason, the report should include cost estimates for each recommendation. The surveyor may elect to recommend a package of countermeasures that corrects the greatest number of problems in the most cost-effective manner. In particular, the surveyor should point out those countermeasures which, if implemented, would correct more than one security problem. Such countermeasures almost always will be the most cost-effective ones to implement.

Step 4. Selection of Countermeasures

The security report is submitted to the park's Superintendent and the park's Physical Security Coordinator. Copies also may be sent to the Regional Director and the Regional Curator. The person who prepared the report should explain it to the Superintendent and be prepared to provide additional details about any part of it. The manager responsible for implementing security measures will be the one to select which of the recommended countermeasures will be implemented in the facility. Countermeasures not requiring expenditure of funds, such as changing operating procedures or regulations, should be implemented immediately. Changes requiring expenditure of funds should be programmed. Refer to Chapter 12 for guidance on programming. In many instances, the recommendations in a survey report can be implemented in stages. Those requiring no expenditures can be implemented first. Those requiring small cost can be implemented next. Those requiring major funds to correct should be programmed for future fiscal years. In any event, the most serious threats should be countered first.

C. THE PROCESS FOR ASSESSING RISK

Assessing risk requires conducting a vulnerability assessment and hazards analysis. This procedure focuses on the potential threats or hazards that are most likely to happen and which ones would have the greatest adverse impact on the park's museum collection. The assessment and analysis will indicate the probability and the criticality of each potential threat. This section explains in general the principles of carrying out a vulnerability assessment and hazards analysis and provides instructions for using a chart to determine where to apply resources to the protection of museum collections. Use the chart illustrated in Figure 9.1 to assess and analyze hazards.

1. Instructions for using Vulnerability Assessment and Hazards Assessment Chart

   a. Identify the potential threats in the first column. Add other threats if required.

   b. Record the history of past loss events in the second column. Use the rating numbers 0 to 5 listed in Figure 9.2.

   c. Record loss event probability in the third column. Use the rating numbers 0 to 5 listed in Figure 9.3.

   d. Record loss event criticality in the fourth column. Use the rating letters A through F listed in Figure 9.4.

   e. Rank potential loss events in priority in the fifth column. Begin with number 1 and continue in sequence.

The five steps involved in this process are discussed below.

2. Vulnerability Assessment

   The following three factors must be recognized and evaluated quantitatively in order to assess the park museum's vulnerability to the many possible threats and hazards:

   - Loss Event Profile
   - Loss Event Probability
   - Loss Event Criticality

   a. Loss Event Profile is the identification of the threats or hazards potentially affecting the museum collections to be protected. This factor involves steps 1 and 2 of the process.

   Step 1 - Threat Identification

   The threats to museum property and facilities must be considered as "pure risks". They are "loss-only" oriented as opposed to "conventional risks" such as those taken when investing in the stock market and which could result in either a profit or a loss.

Potential Loss Events (L/E) (threats, risks, hazards)	Loss Event History	L/E Proba-bility	L/E Criti-cality	Hazards Analysis Ranking
NATURAL DISASTERS				
Tornado or Wind Storm				
Hurricane				
Severe Thunderstorm				
Sleet/Hail/Ice Storm				
Blizzard or Heavy Snow				
Flash Flood or Tidal Wave				
Slow-Rising Flood				
Drought				
Earthquake				
Volcanic Eruption/Lava Flow				
Range Fire or Forest Fire				
Other (specify)				
INDUSTRIAL DISASTERS				
Explosion				
Structural Collapse				
Structural Fire				
Fuel Supply Failure				
Water Supply Failure				
Sewer Failure or Backup				
Electrical Power Failure				
Extreme Air Pollution				
Fuel Spill				
Chemical Spill				
Other (specify)				
ACCIDENTS INVOLVING:				
Motor Vehicles				
Trains				
Aircraft				
Boats or Ships				
Downed Power Lines				
Broken Water or Sewer Lines				
Broken Fuel Pipelines				
Transport of Chemicals or Fuels				
Transport of Nuclear Materials				
Nuclear Power Plant or Weapon				
Other (specify)				
HUMAN (INCL. CRIMINAL) ACTIVITY				
Riot or Civil Disorder				
Bombing				
Bomb Threat				
Arson				
Terroristic Attack				
Armed Robbery				
Conventional Warfare				
Nuclear Warfare				
Sabotage				
Other (specify)				
MEDICAL PROBLEMS				
Mass Poisoning				
Mass Drowning				
Epidemic				
Water Pollution				
Smog or Air Pollution				
Other (specify)				
CRIMINAL ACTIVITY (non-emergency)				
Burglary				
Larceny-Theft				
Embezzlement				
Vandalism				
Shoplifting				
Other (specify)				

Figure 9.1. Vulnerability Assessment and Hazards Analysis Chart

Among the pure risks potentially affecting museum property and facilities are those listed in Section A of this chapter. Recognizing which of those potential loss events could occur in the park environment and cause loss or damage of property may not be easy. But it is essential that such potential threats be identified.

Step 2 - Loss Event History

Start by recording the history of any loss events that have occurred in the past. In the column headed HISTORY, assign numerical ratings from 0 to 5 based on past occurrences in the park. At this stage, do not consider the probability of future occurrences but only whether or not the event has occurred in the past. Base this rating on the entire past history of the park or facility being analyzed, including (when known) the history of the site before its operation by the National Park Service. Use numerical ratings identified in Figure 9.1.

0 - No loss events of this type have ever occurred.

1 - One or two such occurrences; minimal damage; few people affected; minor problems easily handled.

2 - Less than four occurrences; minor damage; more persons involved; minor expense or dollar loss; some difficult problems.

3 - More than three occurrences; some major damage but restricted in area or facilities involved; many people involved; several problems and overall major expense or dollar loss.

4 - More than three occurrences; extensive damage; large numbers of people involved, suffering personal problems and property damage; many problems; much expense or heavy dollar loss.

5 - More than three occurrences; very heavy damage; large numbers of victims; many complex problems; unbearable expense or dollar loss.

Figure 9.2. Numerical Ratings for Loss Event Profile

b. Loss Event Probability is the determination of the likelihood or probability of those threats becoming actual loss events.

Once the threats have been charted, it is necessary to determine the probability of each potential threat occurring in the future. Use the following concept: The more ways a particular event can

occur in given circumstances, the greater the probability that it will occur. For example, a park has an extensive maintenance facility with several shops full of expensive tools and equipment, vehicles, and supplies. Suppose that the particular loss event of concern is theft of portable tools and equipment. What are the circumstances which could lead to loss of some or all of the tools and equipment in the shops? The more apparent circumstances are as follows:

- Tools are not locked in cabinets at night.
- The shop buildings have large windows close to the ground.
- Door locks are not strong enough to prevent forcible entry.
- No inventories of tools are made.
- There are no procedures for signing out tools to be used elsewhere.
- Portable tool chests in the backs of pickup trucks are never locked.

It would be difficult to state the relative probabilities of each of these circumstances as a potential cause of theft. However, keep in mind that the more ways a particular event can occur in given circumstances, the greater the probability that it will occur.

In determining loss event probability, it becomes apparent that some of the listed events cannot occur or cannot impact upon the facility being analyzed. For example, if the park being analyzed is in the Southwest, there is little point in being concerned about the possibility of a hurricane. However, this same park might be at considerable risk from flash floods, water supply failure, or burglary. Once the impossible loss events have been eliminated, all remaining threats are possible to some extent and their probability must be determined.

Step 3 - Loss Event Probability

Once the losses that could occur have been determined, a rating is assigned to each one. This assignment is made without consideration of any precautions or countermeasures that later may be taken to reduce or eliminate the threat. Figure 9.2 lists the six categories of probability that have been established. The assigned ratings will bear a number corresponding to one of these six.

0 - Virtually impossible	Given no changes, the event will never occur.
1 - Probability Unknown	Insufficient data are available for an evaluation to be made.
2 - Improbable	The event is less likely to occur than not to occur but still is possible.
3 - Moderately Probable	The event is more likely to occur than not to occur.
4 - Highly Probable	The likelihood of occurrence is much greater than that of non-occurrence.
5 - Virtually certain	Given no changes, the event will occur eventually.

Figure 9.3. Numerical Ratings for Loss Event Probability

In assigning these probability ratings, the past loss history of the park needs to be acknowledged. Other factors that may influence the ratings include: new construction that has taken place in flood-prone areas; recent flood control work has lessened the chances of a flood; there are additional industrial plants or heavier truck traffic in the area; there are storage areas nearby for flammables, explosives, or chemicals; and increased air traffic. Assignment of ratings will be, to some extent, subjective. It is not essential to achieve exact precision. But it is vitally important to be able to segregate all threats of virtually certain probability from all others and to make similar distinctions for each other general category. To compensate for inexactness and subjectivity, the higher of two possible ratings should be assigned when in doubt.

c. Loss Event Criticality is the determination of the impact or effect upon the assets or upon the organization if the loss does occur.

Highly probable threats may not require much in the way of preventive or counteractive measures if the net loss or damage they would produce is small. But moderately probable or greater threats should command greater attention if the impact of the loss would be great. Thus, while it should be considered highly probable that someone will steal the ball point pen from a visitor registration desk, it may cost more to prevent that loss than it would to continue to replace stolen pens. On the other hand, it may be that arson to an historic structure is only moderately probable or improbable but the impact of that building's loss

would be so great that it deserves the application of full protective measures.

Loss impact can be measured in several ways. Effect on employee morale, effect on public relations, and effect on our reputations are some indirect costs. Perhaps the most important direct costs concern the dollar value of the lost or damaged property and the costs encurred in its repair or replacement. <u>These costs become particularly crucial when the property is a museum collection</u>. In addition, cost considerations become most important because the only really useful way to evaluate proposed preventive and counteractive measures is to compare estimated costs of losses with the costs of preventing or minimizing those same losses.

Step 4 - Loss Event Criticality

Assign a criticality rating to each of the threats that earlier have been determined to be potential causes of loss. Figure 9.3 lists the six categories of criticality. The assigned ratings bear a letter corresponding to one of these six categories.

A - Fatal	A loss would result in the abandonment or long term discontinuance of the enterprise.
B - Very Serious	A loss would be a subject for deliberation by management as to whether or not to continue the enterprise; major policy changes may be necessary.
C - Moderately Serious	A loss would have noticeable impact upon the enterprise and would require attention from senior management.
D - Relatively Unimportant	A loss would be covered by normal contingency planning.
E - No Effect	The impact of the loss would be so minor that it would have no measurable effect on the enterprise.
F - Seriousness Unknown	A provisional rating only; it must be replaced by one of the first five before establishing priorities for preventive or counteractive measures application.

Figure 9.4. Numerical Ratings for Loss Event Criticality

3. Hazards Analysis

Step 5 - Hazards Analysis Rating

Arrange all of the rated threats into a sequence in priority according to their probability/criticality ratings. The most serious threats should be listed first (e.g., they should have a low number hazard ranking). On the chart, in the column headed RANKING, number the threats in priority beginning with number 1. It is possible to rank two or more threats alike. Simply give them all the same number. In assigning priorities, criticality is weighted more than probability. When several threats have the same probability of occurrence, rank them according to their respective criticality ratings. Moreover, the fatally critical threats are ranked higher in priority than all others regardless of their respective probabilities. Thus, a fatal yet improbable threat would receive a higher priority than a moderately serious yet highly probable threat.

When all charted threats have been given a priority number according to their probability/criticality ratings, the task of hazards analysis is completed. It remains only to determine what preventive or counteractive measures can be implemented to relieve the threats and to implement first those measures which will be effective against the higher priority threats.

D. PHYSICAL SECURITY[1]

1. The NPS Physical Security Program

The term "physical security" has a general and a technical definition. They are as follows:

- General Definition: all measures that are intended to prevent acts of violence against persons, destructive unauthorized access to, or removal of, property.

- Technical Definition: the control of the physical environment, primarily by physical means, to include barriers, locking mechanisms, electronic or mechanical systems, signage, design and layout of facilities, and protective lighting, in order to deny, delay or discourage unauthorized or illegal intrusion by persons.

The NPS Physical Security Program is based on the concept of **crime prevention**. Crime prevention is defined as the anticipation, recognition, and appraisal of a crime risk and the initiation of activites to remove or reduce it. A park's Physical Security Program seeks to remove or reduce crimes against all property (e.g., anything having monetary or intrinsic value) by reducing the opportunities for criminal activity. Simply stated:

Means + Motive + Opportunity = CRIME

Little can be done to influence the motives of potential criminals or to eliminate their skills. However, park staff can take many actions to reduce the opportunities for criminal activity. Therefore, as with preservation, prevention is the goal of a park's Physical Security Program for museum collections. Refer to Appendix G for NPS requirements for physical security of museum collections.

The thrust of the NPS Physical Security Program is along four main lines: employee training, standards development, preventive planning, and correction of existing problems.

a. Employee Training

Training efforts are intended to make employees aware of the extent and causes of crime and security problems and to give them the skills needed to combat these problems. Training sessions for all park employees should include some time devoted to museum collections security. This training should emphasize the need for constant vigilance on the part of all park staff to guard against theft, vandalism, and fire. The training should be organized to inform personnel on the action to be taken when confronted by an incident. Emphasis needs to be placed on reporting procedures,

prompt reporting of missing objects, unusual incidents, disturbances, or suspicious conduct. Training also should include the steps for response to fire, including the use of hand-held fire extinguishers and personnel to call.

b. Standards Development

The Park Service has adopted the standards published by Underwriters Laboratories, the National Fire Protection Association, and the Law Enforcement Standards Laboratory and the Fire Research Center of the National Bureau of Standards. These performance standards deal with such matters as intrusion and fire detection devices, door and window assemblies, locking devices, and equipment for law enforcement personnel and patrol vehicles. By using these free, scientific sources of information, NPS is better prepared to adopt and employ cost-effective security and fire protection measures. Standards for the protection of historic structures and objects in accordance with the NPS Management Policies (Dec 88) are outlined in the Cultural Resource Management Guideline (NPS-28).

c. Preventive Planning

Preventive planning consists of two parts. The first is an effort to "design out" security problems during the planning stages of a project. The second involves writing and implementing a Crime Prevention and Physical Security Plan for each NPS park and office.

1) Designing out problems. This part requires the cooperation of architects, engineers, exhibit designers, historic preservation specialists, interpreters, maintenance personnel, curators, and others who are involved in various ways during the planning process. Designing out potential problems takes place whether the plans are for a new exhibit in an existing visitor center, for a new visitor center with new exhibits, for the refurnishing or restoration of an historic house, or for an historic structure that is to be used adaptively for offices, quarters, or other park functions. In the initial stages of the planning process, requirements are established for the level of security that will be needed, based on the nature and value of the structure and its contents. At all subsequent stages, the plans are reviewed to ensure that these requirements will, in fact, be met in the finished product.

   For example, in reviewing the plans for a new visitor center that will include an exhibit room and space for a museum collection storage, one needs to examine the plans and specifications for the building from the perspective of a burglar trying to gain access. Accordingly, look at door and window hardware, glazing, lighting, roof construction, routes for access to openings and to the roof, check for places in which to hide, and try to determine if an intrusion

detection system will be required to compensate for any weaknesses inherent in the design when the design itself cannot be changed. If potential problems are found during this review, written comments and suggestions for corrective action can be prepared for submission to the designer. There are two options for dealing with the identified problems. The problems can be corrected before the plan can be approved or it can be determined that the correction of some problems will not be cost effective or that they can be dealt with just as effectively after construction is completed. Decisions made at all levels <u>must</u> be documented.

2) <u>Crime Prevention and Physical Security Plans</u>.

Each park's crime prevention program includes the following:

- A security survey to determine vulnerability to criminal activity.

- Preventive measures to reduce or eliminate vulnerability.

All the park plans have the following common elements:

- Leadership and participation of management in the development and operation of the security program.

- Regular security surveys by qualified personnel and a provision for corrective actions to be taken in response to the results of the surveys.

- The orientation and training of all employees (permanent, temporary, seasonal, and volunteers) in security awareness, with emphasis on proper attitudes and defining each employee's security responsibilities.

- An appropriate level of security for all park property, including museum collections, capital equipment, supplies, buildings, money, firearms, and historic sites, monuments, and ruins.

- An appropriate level of security for all concessioner property.

- Security and protection of all visitors and employees against such crimes as robbery, assault, rape, and thefts from cars and camp sites.

- Dissemination of crime prevention information to all visitors via posters, handouts, and messages in interpretive presentations if appropriate.

- An annual review and analysis of the park's crime and security problems followed by implementation of appropriate

preventive measures and necessary changes to the park's Plan.

- Appointment of a fulltime or collateral duty Physical Security Coordinator in each park and office to work with the counterpart in the Regional Office.

d. Correction of Existing Problems

Correcting museum security problems is based on a security survey. Refer to Section B of this chapter for guidance on security surveys. These reports are prepared following intensive surveys of park facilities and interviews with key people on the park's staff. Survey reports may recommend changes in operating procedures, improved key control, replacement or augmentation of inadequate door and window hardware, installation of security glazing or lighting, installation of intrusion or fire detection systems, structural modifications to a building, addition of locks to exhibit cases, increased surveillance of exhibit areas during public hours, or creation of an emergency operating plan for protection of park resources in case of a disaster.

The several types of actions that can be taken to improve security of park museum collections are outlined in Section E of this chapter.

E. CORRECTIVE ACTIONS TO ENSURE MUSEUM SECURITY[1]

1. Catalog/Inventory Museum Collection

   Complete the cataloging of the park's museum collection. Cataloged objects are less likely to be stolen and more likely to be recovered because a full description can be made available to law enforcement agencies. Photograph the museum collection or at least the more valuable or sensitive objects. Refer to the NPS Museum Handbook, Part II, for procedures on cataloging museum objects.

   In accordance with the NPS Museum Handbook, Part II, conduct an inventory of park's museum collection on an annual basis. A 100 percent inventory must be conducted on all controlled museum property. Update the dollar values placed on individual objects in a collection so that Superintendents and other managers will be aware of the value of the property they are responsible for protecting and preserving. Refer to Chapter 2 of this handbook for guidance on valuating park collections.

2. Staff Responsibility

   One person on the park staff should be delegated the responsibility for the security of the museum collections. The individual assigned this responsibility should be familiar with the museum operation and the nature of the collection. In many parks, this responsibility may be assumed by the Physical Security Coordinator. In parks with large collections, the day-to-day responsibility may be assigned to the curatorial staff. The curatorial staff needs to work with the Physical Security Coordinator to implement and maintain the program. Responsibilities include knowing the nature of the collection, conducting periodic inventories of the collection, checking all spaces housing museum objects for signs of vandalism and other hazards to collection, noting status of housekeeping, and ensuring that security systems are properly functioning. In addition, this person should establish and maintain contact with the park's law enforcement staff and, if appropriate, with local police.

3. Key Control

   Improper key control weakens security. This important procedure requires ongoing maintenance and cooperation by all staff. Distribution of keys to staff having no need to enter museum collection spaces (e.g., storage, exhibit cases) after hours increases the risk of loss because of lost or stolen keys. Laxity in key accountability invites unauthorized possession and possible duplication of keys. The steps taken to ensure key control are as follows:

   a. Establish written procedures to be signed by the park Superintendent designating the park staff who are authorized access to museum collections storage spaces and exhibit cases. Refer to item 4 below for guidance on preparing these procedures.

These procedures should state who may keep keys permanently, on a temporary basis, or only during work hours. Keys to museum spaces should not be issued to staff whose need for access is occasional. Procedures should indicate that all staff and visitors not authorized entry to museum collections storage must be accompanied by appropriate park staff (e.g., park curator).

b. Keys issued to park staff for access to museum collections storage spaces or exhibit cases must be accounted for by a signed Receipt of Property Form DI-105 or its equivalent. A copy of that form must be retained in a park file.

c. Review key control accountability once a year to ensure that records are current. When an employee with curatorial responsibilities permanently or temporarily transfers from the park, ensure that all museum keys are returned and acknowledged.

d. Keep all keys to museum specimen storage cabinets and to museum exhibit cases in a secure key cabinet or other locked container. The container should be located in the museum storage space. Only permanent staff with curatorial responsibilities should be issued a key to this container.

4. Museum Collection Access Procedures

Prepare a written set of procedures for access to the park's museum collection. These procedures must be approved by the Park Superintendent. The written procedures need to state the purpose of the procedures, outline the park's general access procedures, designate NPS and non-NPS persons who are eligible for access to the museum collections, and state the conditions of access. Refer to Appendix G for the suggested format and language of these procedures.

5. Opening and Closing Procedures

Incorporate museum collections concerns into the park's written opening and closing procedures. All storage spaces should have these procedures. Opening procedures for storage and exhibit spaces should include an inspection for possible unauthorized entry and for thefts during the night. Particularly valuable and sensitive objects should be inventoried. Procedures should include checking for unusual happenings (e.g., leaks in roof). Closing procedures should include checking to ensure that all objects on exhibit are in place and that all cases are locked. Check all spaces in exhibit area for persons hiding and for any fire hazards. Lock all specimen storage cabinets; place keys in key box and secure it; turn out all lights; lock access door(s); and, if appropriate, set alarm systems. Refer to Appendix G for sample Opening and Closing Procedures.

6. Identify Sensitive/Valuable Objects

Identify irreplaceable or particularly sensitive and attractive objects in the collection, especially those on exhibit (e.g.,

historic firearms, paintings). Carefully analyze the nature and effectiveness of the protection currently given such objects. Keep in mind that a locked glass exhibit case is not necessarily a good form of protection. Many museum thefts have occurred because someone simply broke out the glass. Sensitive objects often require additional protection, such as burglary-resistant glazing or an alarm on the case or perhaps storage in a safe rather than a conventional storage cabinet. To provide additional protection at times of high risk, such as when the museum exhibit space is very crowded or when special activities are taking place, consider altering normal personnel schedules and duty stations or assigning more personnel to attendant duty in the museum space.

7. <u>Hardware for Museum Storage Spaces</u>

   Work with the park's Physical Security Coordinator to inspect and evaluate the effectiveness of protection for collection storage spaces.

   Entrances into the park's museum storage space(s) should be equipped with metal or <u>solid-core</u> wooden doors that have dead bolt locks. Dead bolt locks must have a 1" or longer throw bolt which inserts into the frame of the door. If hinges for access doors are located on the unsecured side of the door, ensure that the hinge pins are secured to prevent them from being removed facilitating the removal of the door.

   Properly designed and installed locks are important to a museum protection program. A preventive program for protecting museum collections should not rely on the following types of hardware: spring latches, half inch throw deadbolts, key-in-knob locks, and any device installed with screws a half inch or less in length. These devices are designed to provide privacy not security. Locks to museum storage spaces must have an exclusive non-mastered key code.

8. Review the program for protecting museum property records. Are they safe from fire? Are they safe from theft or, if not, are duplicates of all of them kept elsewhere? Catalog and accession records should not be accessible to visitors, researchers, or non-museum employees except under the curatorial staff's supervision. Thefts of an object and its associated records are extremely difficult to prove and to trace.

   Store all paper museum records in a locking, insulated safe, filing cabinet, or vault that maintains an interior temperature of less than 350°F during a one-hour exposure to exterior temperatures of at least 1700°F. Refer to the NPS <u>Museum Handbook</u>, Part II, Chapter 2, for guidance on the protection of museum records. Sources for locking, approved insulated files are listed in the NPS <u>Tools of the Trade</u>.

   Store magnetic media (e.g., floppy disks and tapes) which back up NPS Automated National Catalog System (ANCS) data files in a container (e.g., media safe, media file, mixed media file, or media box) that

will maintain an interior temperature of not more than 125°F during a one hour exposure to an exterior temperature of 1700°F. Media boxes are acceptable only when inserted in an appropriately rated insulated records filing cabinet drawer or safe.

9. Consider providing cloakroom facilities for checking visitors' packs, briefcases, packages, and sharp objects (such as umbrellas) before they enter the museum or the historic house. Many museums and libraries that permit visitors to bring packages and briefcases into their facilities will inspect them on the way out. Some museums require visitors to check everything, even purses, when they enter. Such checking is especially useful when the facility is large or spread out or when many objects on exhibit are small or are not behind glass, as is the case in historic structures.

10. Consider the need for some type of intrusion detection system to either alert protection forces to an after-hours intrusion or to alert visitor center staff to an act of theft during public hours. Some systems will do both. An alarm system can be an appropriate and cost-effective means of supplementing existing physical and structural security measures. Program for a fire detection system. A burglar might make off with one or two items; a fire can totally destroy the entire museum collection. When considerating alarm systems, it is vital to remember that such systems offer no protection in and of themselves. <u>They serve only as extensions of the eyes and ears of the staff: if there is no one to respond to an alarm, its ringing is of no value</u>. Park curatorial staff should work closely with the park's Law Enforcement Specialist to ensure that a proper intrusion detection system is in place in museum exhibit and storage spaces. Park staff needing to add or upgrade intrusion detection systems should contact appropriate regional staff to determine if design, installation, or procurement assistance is available.

11. Include protection of the museum collection in the park's Emergency Operations Plan (EOP). When a collection includes irreplaceable, extremely valuable, or unique objects, park personnel should be thoroughly trained to act promptly and properly in an emergency that threatens these objects and should be prepared to remove them from the museum after seeing to the safety of visitors and other staff. Refer to Chapter 10 for guidance on museum collections emergency planning.

F. FIRE PROTECTION

Fire can cause the most devastating damage to a park's museum collection. Stolen and damaged objects can be recovered and stabilized; however, an object subjected to a fire may be lost forever. Fire also is one of the most likely disasters to occur. Human carelessness and congestion in facilities increases the threat of a fire.

Protecting museum collections from fire involves protecting the structure that houses the collection (e.g., historic structure, visitor center, museum, storage facility). NPS Management Policies (Dec 88) and the Structural Fire Guideline, NPS-58, provide the authority, policy and procedural guidance for establishing a structural fire program to prevent the loss of human life and to prevent damage or destruction to facilities, equipment, and cultural and natural resources. Park curatorial staff should become familiar with the contents of NPS-58. It provides the framework for developing a fire protection program for museum collections.

NPS-58 states that "the most effective means of protecting human life, property, and resources at the park level is a documented fire prevention program." **NPS policy for fire protection stresses fire prevention.** Curatorial staff need to work with the park's Structural Fire Coordinator to ensure that fire protection concerns for museum collections in storage and exhibit spaces are addressed in the park's total fire protection program.

Fire protection includes the following three elements:

PREVENTION
DETECTION
SUPPRESSION

A park's Structural Fire Plan addresses all three of these elements. The potential causes of a fire in museum spaces include:

- Flammable materials (e.g., paints, solvents, packing materials, lumber, and cleaning materials) exposed to overheating.

- Electricity is a primary fire hazard (e.g., defective wiring, fixtures, heaters, and other equipment and the misuse of electrical extension cords).

- Spontaneous ignition of paint rags and cleaning and polishing cloths.

- Careless smoking

- Plumbers torches and cutting torches

- Ignition of escaping flammable gas

- Exposure from nearby burning structures and wildfires

1. Fire Fundamentals

A fire is defined as a chemical reaction between oxygen and a burnable material where rapid oxidation results in the evolution of heat, light, and smoke. A fire develops in four stages. The stages are as follows:

a. Incipient (early) Stage. The fire produces invisible products of combustion. However, it creates no visible smoke or flames and very little heat.

b. "Smoke" Stage. The volume of combustible products increases and become partially visible as smoke. The heat output increases.

c. "Flame" Stage. The combustible products increase and toxic gases are developed. The combustion products and gases produced are hot enough to sustain combustion in themselves. They continue to burn vigorously.

d. Intense Heat Stage. The heat stage quickly follows the flame stage. This stage of fire development presents the major threat to life and property.

2. Fire Prevention

Fire prevention must be practiced by all staff. It includes:

a. Periodic inspection of electrical wiring for defective components, improper installation, and overloaded circuits.

b. Periodic inspection of heating/cooling (HVAC) systems.

c. Maintaining well-organized storage and work spaces.

d. Storing all flammable materials in approved containers outside the space housing museum collections.

e. Keep fire exit routes open and clear.

f. Consult with the park's Structural Fire Coordinator, and, if necessary, the local fire department to request advice and to acquaint fire fighting personnel with the museum collection and its special needs.

g. Enforce a no smoking policy in museum spaces. Evaluate and control other ignition sources (e.g., fires in the fireplace of an historic structure). All risks should be evaluated and specific protective measures must be taken.

h. Request that a fire safety inspection be conducted of spaces housing museum collections. Each park should obtain a copy of the National Fire Protection Association's standard NFPA 911: Protection of Museums and Museum Collections and standard NFPA

913: Protection of Historic Structures and Sites. These standards contain a fire safety self-inspection form for museums and historic structures that is useful in conducting the inspection.

i. Staff need to be trained in the location and operation of fire extinguishers.

j. Practice good housekeeping in museum spaces.

3. Fire Detection

In spite of a good fire prevention program, an early detection system is essential. The factors that may be used to determine the level of fire security include:

- Significance/value of the collection

- Types of fire threats--consider the material makeup of the facility housing the collection, the nature of the collection, proximity of facility to fire fighting team.

- Number of visitors/staff in the facility at one time (Can they exit rapidly? Can the fire be contained long enough for them to get out safely?)

Fire can be detected in its earliest stage. A detection system must be in operation 24 hours a day. There are two types of detectors: smoke detectors and heat detectors.

a. Smoke Detectors

Two commonly used principles of detecting the presence of smoke are the photoelectric method and the ionization method. The advantage of a smoke detector is that it provides faster detection than a heat detector. However, it is more susceptible to false alarms.

1) The ionization type detects the fire before it reaches the "Flame" stage. It can be too sensitive in areas of high humidity and dust. It operates better in areas where the temperature is stable. It does not function reliably in a room with a working fireplace.

2) The photoelectric type responds faster to low energy fires that smolder and give off quantities of visible smoke. Some earlier models had problems with false alarms due to insects entering the detector. Newer models include an insect guard to eliminate the problem.

b. Heat Detectors

These types of detectors are not as sensitive as smoke detectors and are less expensive. They must be mounted on exposed ceiling surfaces. They can work in buildings that are not properly climate controlled. They are most effective in areas where a smoke detector will not function (e.g., room with a working fireplace.

Both types of detectors detect fires with different response times. Each must be installed by a specialist who understands air currents, fire characteristics, and NFPA requirements. The detectors should be tied into a system that sets off an alarm in the facility and at the fire station.

4. Fire Suppression

A fire detection system is effective only if it is combined with a suppression system (e.g., fire extinguishers, stand-pipe, response by fire fighting personnel, automatic sprinkler system). The key to fire suppression in museum spaces is to ensure that the needs of the museum collections are included in a park's Structural Fire Plan.

The museum element of the plan needs to address the following subjects:

- Remote transmission of fire alarms to a fire department.

- Operation and maintenance of any automatic sprinkler systems.

- List of designated persons to respond to a fire and to call fire fighters.

- Training all curatorial staff in the use of fire extinguishers and in procedures to follow in the event of a fire.

- If there is time, and it is safe, a plan to remove important objects in the collection to a pre-designated location that provides basic security.

a. Portable Fire Extinguishers

It is important that everyone know the first requirement in case of a fire: notify the fire department by means of telephone or manual alarm. Only after such notification has been given should attempts be made to extinguish the fire.

The proper use of portable fire extinguishers should be demonstrated and all staff should know where extinguishers are located in the building. They also should know what classes of fire extinguishers to use on different kinds of fires.

Class A extinguishers are suitable for use on fires in ordinary combustibles (e.g., wood, paper, rubbish, and many plastics). They are used where the quenching, cooling ability of water or of solutions containing large percentages of water are most effective. Extinguishers rated for Class A hazards are water and loaded-stream. Multi-purpose dry-chemical types also are suitable because of their special ability to retard combustion.

Class B extinguishers are used on fires in petroleum products, flammable gases and other flammable materials (e.g., paints, thinners, and solvents). They are effective where an oxygen-exclusion or flame-interruption effect is essential. Extinguishers rated for Class B hazards are carbon-dioxide, ordinary dry-chemical, multipurpose dry-chemical, and to a limited extent, loaded stream.

Class C extinguishers are for fires in energized electrical equipment and wiring, where the dielectric conductivity of the extinguishing agent is important. Water or water-solution extinguishers, of course, cannot be used on electrical fires because of the shock potential. Carbon dioxide, sodium and potassium carbonate base dry chemicals, and multi-purpose chemicals are used to extinguish Class C fires. Until recently Halon also was used. See below for information on Halon.

Class D extinguishers are used on fires in combustible metals, such as magnesium, titanium, zirconium, sodium, and potassium. Class D extinguishers are designated "dry powder" extinguishers and contain such specially treated agents as sodium chloride or graphite. It is highly unlikely that a park museum would require a Class D fire extinguisher.

The multi-purpose, dry chemical Class ABC extinguisher is commonly used. It puts a coating of powder over the fire, cutting off the oxygen. Do not use "Purple K" dry chemical extinguishers in museum spaces.

All park curatorial staff should be trained on how to use a fire extinguisher. Ensure that all extinguishers in museum space are inspected annually.

b. Sprinkler Systems

A sprinkler system consists of a network of overhead pipes with spaced outlets called "heads" that open at a predetermined temperature to discharge water onto the fire area. There are four basic types of systems and some variations:

1) Wet pipe system. In this system the pipes are filled with water under pressure and the water is discharged immediately by any head that opens due to heat from the fire.

2) Dry pipe system. This system is used in areas where freezing occurs. In this system, the pipes are filled with air under pressure and when a head opens, it causes a drop in air pressure that activates a valve allowing water to flow into pipes and discharge from the open head(s).

3) Preaction system. In this dry pipe system, water flow is started by an independent heat or smoke detection system rather than by the opening of a head; thus, water is available immediately to any head that opens due to heat of the fire.

4) Cycling system. As with preaction systems, these systems are charged by action of smoke detectors, but also are turned off when the detectors sense no more fire. The system turns the heads on again automatically, if the fire should reoccur.

5) Deluge system. In this system all heads are open at all times and the pipe system contains no water until a detection device opens a valve. The sprinklers discharge a maximum amount of water throughout the protected area.

There is always concern about the accidental discharge of water in a sprinkler system. The record indicates that there have been many museum fires and very few accidental discharges. Accidental discharges occur because of human error or improper maintenance to the system. The special preaction systems further reduce the chance of an accidental discharge.

c. Halon

Until recently Halon has been used in suppression systems and portable extinguishers. This material is a particularly suitable alternative for large paper and photographic collections, because it is harmless to paper (unlike water). However, Halon has proven to be a major threat to the worldwide environment. Accordingly, the National Park Service's policy is that no new Halon systems be installed in parks and that all existing Halon systems be programmed for replacement. The fire suppression industry is experimenting with substitutes for Halon.

5. Assistance

Park curatorial staff should work closely with the park's Structural Fire Coordinator to ensure that a proper fire detection/suppression system is in place in museum exhibit and storage spaces. Park staff needing to add or upgrade fire protection systems should contact appropriate regional staff to determine if design, installation, or procurement assistance is available.

G. SELECTED BIBLIOGRAPHY

Advisory Council on Historic Preservation
1989 Fire Safety Retrofitting in Historic Buildings. Washington, D. C.: Advisory Council on Historic Preservation and the General Services Administration.

Alsford, Denis
1984 "Fire Safety in Museums," MUSE, Summer, pp. 18-23. Ottawa, Ontario, Canada: Canadian Museum Association.

ASIS Standing Committee on Museum, Library, and Archive Security
1990 Suggested Guidelines in Museum Security. Arlington, VA: American Society for Industrial Security (ASIS).

Barnard, Robert L.
1988 Intrusion Detection Systems: Principles of Operation and Application (Second Edition). Boston, MA: Butterworths.

Bostick, William A.
1977 The Guarding of Cultural Property: Protection of the Cultural Heritage. Series--Technical Handbooks for Museums and Monuments. Paris, France: UNESCO.

Broder, James F.
1984 Risk Analysis and the Security Survey. Boston, MA: Butterworths.

Burke, Robert B. and Adeloye, Sam
1986 A Manual of Basic Museum Security. Great Britain: International Council of Museums (International Committee on Museum Security).

Center for Occupational Hazards
1985 Fire Prevention in the Conservation Laboratory. New York, NY: Center for Occupational Hazards.

Cherry, Don T.
1986 Total Facility Control. Boston, MA: Butterworths.

Department of the Army
1979 Physical Security. Field Manual No. 19-30. Washington, D.C.: Department of the Army.

Departments of the Army, Navy, and Air Force
1981 Maintenance of Fire Protection Systems (Army TM 5-695; NAVFAC NO-117; Air Force AFM 91-37). Washington, D.C.: Departments of the Army, Navy, and Air Force.

Fennelly, Lawrence J. (Editor)
1983 Museum, Archive, and Library Security. Boston, MA: Butterworths.

Fischer, Walter R.
1976 "Fire Safety Systems: Protecting Our Treasures from Threat of Fire." Technology and Conservation (Fall), 1:2:14-17.

Gendert, Slade R.
1982 Protecting Your Collection. New York: The Haworth Press.

Gigliotti, Richard and Ronald Jason
1984 Security Design for Maximum Protection. Boston, MA: Butterworths.

Hopf, Peter S. (Editor)
1979 Handbook of Building Security Planning and Design. New York: McGraw-Hill Book Co.

Howie, F. M. P.
1987 Safety in Museums and Galleries. Boston, MA: Butterworths.

Keck, Caroline K. and Block, Huntington T.
1966 A Primer on Museum Security. Cooperstown, NY: New York State Historical Association.

Menkes, Diana (Editor) based on document by George H. H. Schroder
1981 Museum Security Survey. Paris, France: International Committee on Museum Security, International Council of Museums (ICOM).

Morris, John
1979 Managing the Library Fire Risk. Berkeley, California: Office of Risk Management, University of California.

National Fire Protection Association (NFPA) Standards.

1987	NFPA 1:	Fire Prevention Code
1988	NFPA 10:	Portable Fire Extinguishers
1990	NFPA 10L:	Servicing Fire Extinguishers
1987	NFPA 13A:	Inspection, Testing and Maintenance ofSprinklers
1990	NFPA 70:	National Electrical Code
1988	NFPA 72:	Installation of Fire Systems
1988	NFPA 110:	Emergency and Standby Power Systems
1985	NFPA 910:	Libraries and Library Collections
1985	NFPA 911:	Museums and Museum Collections
1987	NFPA 913:	Historic Sites and Structures

Quincy, MA: National Fire Protection Association

Noblecourt, Andre
1958 Protection of Cultural Property in the Event of Armed Conflict. Museums and Monuments Series, No. 8. Paris, France: UNESCO.

Sable, Martin H.
1983 "The Protection of the Library and Archive: An International Bibliography." Library and Archival Security, (Summer/Fall), 5:2/3:1-183.

Schnabolk, Charles
1983 Physical Security: Practices and Technology. Boston, MA: Butterworths.

Schur, Susan E.
1980 "Fire Protection at Mount Vernon: Incorporating Modern Fire Safety Systems into an Historic Site." Technology and Conservation, (Winter), 5:4:18-25.

Shirar, Gerard (compiler)
1978 Protecting Works of Art. (consists of articles from Security Management journal). Arlington, VA: American Society of Industrial Security.

Sloane, Eugene A.
1977 The Complete Book of Locks, Keys, Burglar and Smoke Alarms, and Other Security Devices. New York: William Morrow and Co., Inc.

Synk, J. A.
1976 "Art and Artifact Theft: How to Protect the Past." Technology and Conservation, pp. 20-23.

Tillotson, Robert G. (Edited by Diana Menkes)
1977 Museum Security/La Securite Dans les Musees. Paris, France: International Council of Museums (International Committee on Museum Security).

Tiszkus, A. T. and Dressler, E. G.
1980 "Fire Protection Planning for Cultural Institutions: Blending Risk Management, Loss Prevention, and Physical Safeguards." Technology and Conservation, (Summer), 5:2:18-23.

Trimmer, H. William
1981 Understanding and Servicing Alarm Systems. Boston, MA: Butterworths.

Weldon, Stephen W.
1983 "Fire Protection Systems and Fire Prevention Techniques," Museum, Archive, and Library Security, pp. 177-234. Boston, MA: Butterworths.

Wilson, J. Andrew
1989 "Fire Fighters--An Automatic Fire Suppression System is Among Your Museums's Best and Safest Forms of Insurance," Museum News (November/December), 68:6:68-72. Washington, D. C.: American Association of Museums.

H. ENDNOTES

1. The material used in these sections is similar to material published by the author in the book Museum, Archive, and Library Security edited by Lawrence J. Fennelly (1983), Chapter 1, pp. 3-15. The material is derived from early manuscripts written by the author for use in the National Park Service.

CHAPTER 10. MUSEUM COLLECTIONS: EMERGENCY PLANNING[1]

Page

A. INTRODUCTION

The slow deterioration of museum collections is inevitable. Park curatorial staff can try to minimize this deterioration through proper care. However, many collections are not lost through the slow processes of gradual deterioration, human carelessness, improper use, or benign neglect, but through the sudden violence of disasters from which they are inadequately protected, (e.g., earthquakes, volcanic eruptions, landslides, tornados, hurricanes, floods, and wildfires). All too frequently, it seems, we hear of another appalling event. We are shocked at the awesome destruction shown vividly by the news media, and we are horrified at the plight of the victims. Less frequently we learn of the great toll that such catastrophes take of our cultural heritage, especially historic structures and museum collections. Nevertheless, natural catastrophes probably are the greatest single cause of attrition to the world's cultural heritage.

The purpose of this chapter is to present guidance for park staffs in protecting museum collections from the effects of serious emergencies and disasters. See Appendix G, Section C for laws and NPS Management Policies, guidance documents, and requirements relevant to emergency planning. The information presented in this chapter is based upon the following three assumptions:

1. No park museum collection is totally immune to disasters and their effects.

2. Planning for museum disasters will be done within the context of overall park emergency operations planning. The information presented in this chapter should be used to develop a Museum Disaster Plan that becomes part of a park's Emergency Operations Plan.

3. No park will have access to unlimited resources (funds, personnel, equipment, supplies, etc.) with which to prepare for or cope with a disaster. In most situations each park will need to request outside assistance from other parks, from the regional office, and/or from the local community.

In developing a plan, a primary objective should be to plan well enough so that those responsible for park operations during an emergency will be able to focus on solving major problems rather than having to first bring order out of chaos because of a lack of planning. If the plan considers all predictable and routine matters, emergency operations personnel will be able to deal with the unpredictable or unusual situations that surely will develop. The primary goal of emergency planning is to avoid the loss of resources (in this case, museum collections) affected by the emergency. **Advanced planning is the key to meeting that goal.** How effectively damage is limited in a disaster situation depends to a very great extent upon the thoroughness of the planning effort.

B. OBJECTIVES OF EMERGENCY PLANNING

Emergencies may take many forms, but all of them have one basic characteristic: they get rapidly and progressively worse if they are not dealt with quickly and positively. It is this "runaway" quality that makes them so dangerous.

It is customary for cultural institutions to define the objectives for disaster plans as the protection of life and property. However, focusing on protection may lead to an ineffective plan unless one focuses also on control. If the situation is out of control, nothing can be protected.

Emergencies become disasters only when they are out of control. Thus, the primary objectives of emergency planning are as follows:

1. To anticipate and, if possible, to avoid emergencies.

2. To retain control when an emergency occurs.

3. To recover control as quickly as possible if it is lost.

C. HAZARDS TO MUSEUM COLLECTIONS

Disasters do not just suddenly appear. Certain hazards exist in all parks, but some event or accident must occur before an emergency situation can develop or before a disaster can threaten a collection. For example, there may be a river flowing through the park. Each spring the river level rises but usually does not flood. Although the river seldom causes any problems, the potential for flooding always exists. For a flood to occur, some event has to take place upstream, such as exceptionally heavy rainfall, rapid snow melt, or a broken dam. Flooding may not actually threaten a collection if it is housed in a building located on high ground. However, if the collection is housed on the river's edge, even a minor flood may cause extensive damage.

When planning for emergencies, it is important that all potential hazards, such as river flooding, be identified. It is equally important that all identified threats be evaluated in terms of how likely they are to occur and what would be the impact of their occurrence on the park's collection. Only in that way can the museum disaster plan focus on those emergencies and potential disasters that are most likely to occur or that are most likely to cause the greatest losses.

1. Identifying Hazards

The variety of hazards that can cause emergencies and disasters include but are not limited to the list in Figure 10.1. Many parks will find that they face only a limited range of hazards, while others, particularly those in urban areas, will face a multitude of hazards. When they occur, they will produce varying impacts upon museum collections. The varying kinds and degrees of damage can be generally characterized as follows:

a. Heat Damage

This type of damage will result from fires, usually structural, but potentially from exposure of objects to range fires and volcanic activity as well. Heat causes rapid oxidation of most materials and, potentially, their total consumption. Smoke from fires can coat museum objects with soot. Often greasy, soot is very disfiguring and difficult to remove. Fire probably is the most serious threat to all park museum collections and is the most likely to be a hazard in all parks.

b. Water Damage

This type of damage can occur as a consequence of many disasters. It is a direct consequence of burst water pipes, floods and, often, of hurricanes. It is frequently an indirect consequence of tornados (which often are accompanied by rain) and of fire fighting activities. Wooden and other organic objects affected by water may warp, split, check, and rot; the corrosion of metals will be accelerated; stone and masonry may erode. In addition,

water enhances bacterial action, supports mold growth, dissolves pigments and finishes, and may deposit chemicals and fuels onto objects, causing other forms of secondary damage.

c. Physical Damage

Most often this damage is the result of structural damage to the building housing museum collections, but can occur even when the building itself sustains little or no damage. Structural damage results in broken objects. If the building has sustained severe damage, objects also may be buried in the rubble of the building. Structural failure can cause broken water, sewer, and fuel lines that can lead to water and chemical damage or to fires. Often the severest impacts of an earthquake on collections are not due to building failure itself, but rather to fires and flooding which occur as a result of that failure.

d. Chemical and Radiological Damage

These types of damage can result from smoke, chemical spills, burst fuel lines and storage containers, waterborne and airborne substances, nuclear accidents or warfare, and a host of related events generally known as industrial accidents. As noted above, this form of damage often occurs secondarily as the result of some larger-scale, most often, natural event. Objects attacked by chemicals can be expected to corrode or dissolve or become weakened or stained. Hard or ionizing radiation may not directly affect objects, though under certain circumstances, such radiation could cause an object to become radioactive and thus prevent its subsequent use by humans.

Natural Disasters	Accidents that Involve
Blizzard or heavy snow fall	Bodily injury
Hurricane	Broken fuel pipelines
Severe thunderstorn	Broken water or sewer pipes
Sleet, hail, and ice	Downed power or phone lines
Tornado and wind storm	Aircraft (crashes)
Flash flood	Construction equipment
Slow-rising flood	Motor vehicles
Tidal wave	Ships and boats
Range or forest fire	Trains
Earthquake and mud slide	Transport of chemicals or fuels
Volcanic eruption or lava flow	Transport of nuclear materials
Drought (prolonged)	Nuclear power plants or weapons
Industrial Disasters	**Human Activity**
Electrical power failure	Accidents by individuals
Fuel supply failure	Armed robbery
Water supply failure	Arson
Sewer failure or backup	Bombing
Explosion	Bomb threat
Extreme/prolonged air pollution	Conventional warfare
Fuel spill (major)	Nuclear warfare and fallout
Chemical spill	Riot and civil disorder
Radiological materials spill	Sabotage
Structural collapse	Terrorist attack; hostage taking
Structural fire	Vandalism

Figure 10.1. Hazards that can cause emergencies and disasters

2. Assessing Risk

The following three concepts are involved in assessing dangers: hazard, vulnerability and risk. "Hazard" is the probability that a disastrous event of a given magnitude or severity will occur in a particular place. "Vulnerability" means the degree of loss that will be sustained by a resource from a disastrous event of a given magnitude. Vulnerability is also the degree of exposure to a hazard. "Risk" is the probable loss from natural disasters of various kinds combining the hazards of a location and the vulnerability of objects there. Risk assessment for disasters relies on a hazard and vulnerability analysis, defines acceptable levels of risk, and provides assistance in making decisions about locations and preventive measures.

Barclay G. Jones in the book Protecting Historic Architecture and Museum Collections from Natural Disasters explains these concepts and their interrelationships as follows:

Hazards are an attribute of regions or sites. Vulnerability is an attribute of structures and objects. Consequently, human beings, their objects and artifacts and the structures that support and shelter them incur varying levels of risk as a result of their own characteristics and their location in space at different points in time.

Consideration of hazards which are characteristics of regions and sites provides a suitable framework. The question to be addressed is: What is the probability that a natural disaster of a particular type in a given degree of severity will occur in a locale? All specific locations or sites within a geographical region may or may not be equally susceptible to a given type of disaster. It is necessary not only to make a hazards assessment of a region but also a very specific and often quite technical hazard assessment of a site.

The possibility of natural disasters of various kinds cannot be established with certainty because of the many, often subjective, variables at work. The accumulation of experi- ence, the systematic gathering of large quantities of information by sensitive measurement devices and extensive monitoring systems, the results of enormous research efforts and the development of elaborate theories have advanced our understanding considerably. Regions with certain characteristics and sites with specific attributes are clearly more prone to certain kinds of disasters than others. However, such knowledge still does not permit us to state with a high degree of certainty that an event of a given magnitude will or will not occur within a particular period of time. Another important approach to assessing hazards is through the prevalence of events of various kinds. It is a matter of historical record, even though the causes may not be completely understood, that certain regions and certain locations have suffered more or less severe events with greater or lesser frequency than others over time. The assessment of hazards often involves combining a knowledge of relevant attributes with information about prevalence. The purpose of hazard assessment is to determine the kinds of dangers to which one is exposed and the likelihood of their occurring. Vulnerability analysis concerns assessing the kind and likely extent of damage that can be done by a given hazard. In many instances we may be able to do very little to change our exposure to hazards, but in others we may be able to do a great deal to reduce vulnerability.

The vulnerability of buildings and other structures and objects is of tremendous variety. On the one hand it derives from the characteristics of the natural disaster under consideration and other events that may accompany it. On the other hand, it is determined by the characteristics of the buildings and objects that are of concern. However, the kinds of damage that can be inflicted can be generally grouped rather simply under three types of effects: kinetic, chemical, and bacteriological.

Kinetic effects imply motion in which some force is brought to bear on an object. Damage results when there is physical deformation of the objects. This kind of damage can occur when objects fall onto hard surfaces, overturn violently, are struck by other objects in motion whether airborne or waterborne, and when objects are subjected to the stress of shear, torsion and bending. The motion does not need to be violent to cause damage but may be relatively subtle such as the case with spalling and eroding and the actions of freezing and thawing. Abrasion and wear are similar.

Chemical effects are ones that result in changes in the chemical composition of the object. Extremes of temperature, the action of fire, long immersion in water, exposure to air, contact with quite foreign chemical substances of various sorts can lead to these kinds of changes. Oxidation of metals is a familiar form of this effect.

Bacteriological effects are ones in which disasters in one way or another precipitate bacteriological action which may have deleterious effects on objects. Mildew, mold, fungus growths and other harmful bacteriological actions are examples. These effects are often precipitated by drastic changes in wetness and dryness and immersion in water.

Vulnerability analysis consists of anticipating the kinds of effects that can damage or destroy buildings or objects. Measures can then be taken to prevent conditions from occurring that would result in those effects. In many cases it is sufficient to be prepared to reverse the effect quite rapidly after it has occurred.

It is unlikely that any museum collection in the Service will be vulnerable to all of the hazards listed in Figure 10.1. There are no ice storms in Hawaii and no volcanos in Florida. However, every park museum is vulnerable to some of those potential threats. The extent to which a park museum might suffer from a disaster of technological origin depends upon many of the following factors: the quality of the park's maintenance and fire prevention programs; the quality of the local fire department's program; the construction of the park's building and the nature of the utilities and equipment supporting it; and the proximity of the museum to other buildings and activities and to such facilities as railroads, harbors, airports, highways, and military installations.

A good hazards analysis and vulnerability assessment will consider hazards, vulnerability, and risk, but it should emphasize accurate identification of hazards and vulnerability and be cautious about trying to determine risk with any degree of precision. An uncomplicated approach to determining risk is to employ the concept that the more ways that a particular event--such as water damage--can occur in given circumstances, the greater the probability that it

will occur and, thus, the greater the risk. Planning should be based on the following assumption: be ready for anything, no matter how small the risk. However, it is still desirable to prioritize risks. Prioritizing risks helps to focus attention first on those events that are most likely to cause unacceptable damage and on those events that are almost certain to occur eventually. Failure to prioritize risks can result in a disproportionate amount of time being spent on preparation for events that might not occur or that would have little overall impact if they did occur.

Part of the hazards analysis is a survey of the museum building(s) and its environs to identify potential problems that could cause an emergency situation to develop or, in the event of an emergency, could aggravate the situation. Some of the problems the park may find can be easily remedied, while others may require further study and long-term planning and programming. Each park is unique and will have its own particular concerns and problem areas. A hazards survey designed for a park will identify those areas of concern that will require emphasis in the formulation of the park's museum disaster plan.

D. PROTECTING MUSEUM COLLECTIONS FROM DISASTERS

Protective measures for collections fall into the following four categories: mitigating measures, preparedness measures, response measures, and recovery measures. NPS-28, Cultural Resources Management Guideline, Technical Supplement, Chapter 3 provides a thorough overview of how these measures differ from one another and presents a number of examples of each. A summary of each protective measure is as follows:

BEFORE

Mitigating measures seek to eliminate the hazards that threaten the collection or to reduce the effect those hazards would have if they ever are manifested. Mitigation necessarily takes place in advance of something happening.

Preparedness measures are put in place so that responsible personnel can act appropriately during an emergency, particularly if a disaster might be imminent and they might be able to avert it or minimize consequent damage. Preparedness includes staff training and the development of call up lists, resources lists, and stockpiles of supplies and equipment. Some preparedness measures must be put in place before anything happens, while others come into play only as an emergency develops.

DURING

Response measures are taken when a disaster strikes without warning, when mitigating and preparedness measures have failed to prevent a disaster or when measures have been taken but damage has occurred anyway. The purpose of response measures is to prevent further damage to collections and to stabilize those that have been damaged so that they do not deteriorate further before they can receive attention from professional conservators. Response measures attempt to retain or to reestablish control over the situation.

AFTER

Recovery measures occur after an event has happened. They are designed to enable the park--and its museum operation--to return to normality in an orderly, phased, reasoned, methodical fashion. Recovery measures begin when the disaster situation has stabilized and professionals have evaluated the damage and suggested further, long-term actions. Recovery can be a long process, taking years in some cases. Recovery measures solidify control over the situation.

E. PREPARING THE EMERGENCY MANAGEMENT PLAN FOR MUSEUM COLLECTIONS

Disaster contingency planning must be done with a clear understanding that someday, somewhere in the park a disaster will occur. No amount of precaution and prevention can reduce the threat of disaster to zero. Therefore, it is incumbent on the planner to look not only at how disasters might be averted, but also at what can be done when they do occur. The planner also must realize that a disaster may be widespread and/or result in extensive damage and long-term effects, or it may be very localized and/or result in only minor damage that is quickly corrected. Likewise, the disaster may affect only the collection or it may affect the entire park or even the entire community or region. Localized damages to a collection also may be secondary effects from a disaster nearby, such as ash fallout from a volcano.

Whether it be a fire, a flood, an earthquake, or a hurricane, a disaster may cause injury, death, and destruction. To counter such threats to life and property, the plan must aim to keep losses to a minimum and must lay out a course of action for the staff to follow in all contingencies. Above all, the safety of human life must take precedence when formulating the plan. No museum object is worth more than a human life.

The park's museum disaster plan must outline how the staff should respond when disaster strikes. The plan should:

- Establish procedures for the safe evacuation of visitors and staff, many of whom are likely to be concentrated in the park's museum.

- Include telephone numbers and addresses of all persons, services, and organizations who may be expected to provide support to the park during and after the disaster.

- Provide instructions for salvaging damaged collections and the buildings they are in, and describe materials and equipment that may be needed for salvage and restoration of services.

- Take the human element into account, encouraging imagination, leadership, cooperation, and level-headedness. A lack of any of those qualities will be just as serious as any shortage of blotting paper, plastic sheeting, plywood, or rubber boots.

A written museum disaster plan should be prepared by the park curatorial staff, preferably in conjunction with preparation of the park's overall Emergency Operations Plan. This chapter does not explain in detail how a disaster plan should be developed and written. Consult with persons on the park staff who have participated in the development of disaster plans in the past or who are responsible for their development now. Seek their assistance and cooperation in the development of the plan. Ensure that the person who is in charge of emergency operations takes the museum's resources into account when planning for park emergencies. Ensure that the park's planner and emergency operations staff understand the special

needs of museum collections and why those needs must be taken into account in the overall Emergency Operations Plan. Consult your Regional Curator for guidance.

The park superintendent must take a central role in the development and implementation of an Emergency Operation Plan. The superintendent may choose to delegate some powers during an emergency; however, the superintendent remains the ultimate source of authority. Thus it is vital that the disaster plan have the full support of the superintendent and he be prepared to back the plan with his authority whenever it has to be executed.

An outline of the emergency planning process which leads to the preparation, implementation, and execution of a museum disaster plan is as follows:

1. <u>Assign Responsibility for Planning</u>

   The park superintendent should appoint someone on the staff, usually the park curator, to prepare a disaster plan for the collection or to provide input to the park's protection staff as they prepare an Emergency Operations Plan (EOP) for the park. In either case, the individual(s) will be responsible for ensuring that the collection and its special needs are taken into account, ensuring that all threats and potential impacts are noted, that priorities for mitigation and recovery are set and followed, and that resources for protection of the collection are identified and allocated equitably.

2. <u>Gather Planning Tools</u>

   Everyone concerned with planning to protect museum collections should become familiar with the policies, guidelines and requirements cited in Appendix G of this handbook. They also should solicit assistance from the Regional Curator and the Regional Office's Division of Ranger Activities. Gather useful publications from the regional office and from local or State public protection and civil defense agencies. If the park already has an approved EOP and the planning effort is to add a section to cover the museum, become familiar with that EOP.

3. <u>Contact Local Protection Agencies</u>

   If the park has an EOP, this step generally will not be necessary, because liaison with local police, fire, and emergency services agencies will already have taken place. Liaison with such agencies is essential for two reasons. <u>First</u>, park planners must know about plans that already have been developed for dealing with local regional, and statewide disasters. It is crucial that the park staff know about local plans in particular so they do not count on being supported by local non-NPS resources that already may be committed to higher priority disaster operations. <u>Second</u>, it is important that local agencies know the park's needs and planning efforts so they will be in a position to support the museum and the

entire park appropriately in time of disaster. Liaison also is useful because it affords local non-NPS agencies an opportunity to provide valuable technical assistance and advice. Once established, contacts with local agencies should be maintained throughout the planning effort as well as after the plan is put into effect. As local plans change, the park's plans may have to change. Similarly, as the park's plans change over time, it is important that local agencies know this, in case they have to change their response patterns accordingly.

4. Identify Hazards and Threats to the Collection

The objectives of this step are to systematically identify and analyze the natural, industrial, and war-related hazards that exist in the park and in its surroundings, to determine which ones should be treated as threats to the collection, and to assess the risks of damage. Local emergency services agencies should be able to help the park focus on those hazards that actually or potentially threaten the park. One purpose of this step is to prioritize the application of park resources in order to counter first those threats that are likely to have the greatest impacts.

5. Identify and Prioritize the Museum's Assets

The objective of this step is to determine what assets (e.g., collections, records, exhibits, and equipment) can be damaged by various disasters and to prioritize those assets according to their values and importance to the park. There are two purposes to setting priorities. First, it gives the planners a sense of which assets must be protected ahead of others and how important each asset is to the museum's (or the park's) overall well-being and to its continued operation following a disaster. Second, it establishes priorities enabling the park staff to concentrate on saving the most important assets during recovery and salvage operations following a disaster. Without setting priorities in advance, effort may be wasted on trying to protect or save low value objects at the expense of those that deserve the most attention.

6. Formulate Protection Methods

On completion of steps 4 and 5, it should be clear to the planners what kinds of threats have to be taken into account, what kinds of damages could occur in the museum, and what assets could be affected. The objectives of this step are as follows:

a. Formulate ways to mitigate against threats (loss prevention);
b. Formulate ways to minimize unpreventable damage (loss reduction);
c. Plan on how to respond to events as they occur (preparedness and response);
d. Set general priorities for recovery from damage; and
e. Determine what outside support, personnel, equipment, supplies, and other resources may be needed to cope with disasters.

7. Plan for Command and Control

During the preceding step, the planners determined how to deal with disasters. In this step, they determine who will be responsible for taking action. The plan should be based on the park's existing organization and should depend on its existing chain of command to the fullest extent possible. Instead of setting up some sort of emergency management organization, the park's plan should define an emergency operations mode in which the existing operation, with its known resources and its familiar command structure, simply adopts new priorities and then functions in a more flexible, more innovative, and more streamlined manner. The disaster plan should temporarily change the park's priorities and its methods, not its organization. However, it must be realized that the existing organization might have to be augmented in time of emergency and, especially, in time of disaster because the day-to-day staff may not be able to cope with the situation.

8. Write the Plan

At this point, the planners should be far enough along in their decision making process to actually produce a draft written plan. There is no standard format or content for a museum disaster plan. Consult the Regional Curator for suggestions for a plan format and organization, if the plan is to stand alone. If the plan is to be part of the park's EOP, its same general format should be used. The draft plan should be well integrated into the park's overall EOP (if there is one) and must be reviewed in the regional office before proceeding further. Characteristics of a good plan are as follows:

a. Flexible, Simple and Adaptable

The following information is courtesy of Mr. Philip Ward, Senior Conservation Scientist at the Canadian Conservation Institute, Ottawa, Canada. Mr. Ward's advice has been adapted to be applicable to National Park Service units.

Some emergencies are predictable, but others are not. No emergency plan can anticipate all events that might occur; therefore, your plan must have sufficient flexibility that it can be useful in every contingency. The plan also needs to be flexible to allow for changes in the park's staffing and in the hazards to which the park's collections may be vulnerable. The plan needs to be detailed to minimize the number of decisions that must be made during an emergency. Yet it needs to be simple so that it can be understood and executed quickly and with minimum error and need for interpretation. The simplest plans usually are the most reliable and the most effective. Complexity can delay action and discourage flexibility. The plan needs to be adaptable to any situation that it may not have been specifically designed to cover. In particular, the plan should be able to deal with the many emergencies that are not in themselves major events but which are triggered by other events, often minor. (Through the "domino

effect," one event can trigger a series of others, each perhaps minor in itself, but which collectively result in a serious situation.)

Finally, the plan needs to be designed around the effects of disasters on collections, not just on their causes. Mitigation measures must consider causes, but the other three protective measures must consider effects and the nature of expected damage in order to be most effective.

b. Facilitates Good Communication

Good communications are the best antidote for panic. People--both staff and visitors--are much more likely to respond positively to a difficult situation if they know what is happening. Keep everyone informed of the situation, especially when it changes. Keep the channels of communication open in both directions, so that: information and instructions can reach everyone promptly and their requests can be answered quickly, and their needs can be made known efficiently. Make special arrangements to maintain external communications and prepare alternative channels. In a major disaster the telephone system, for example, may fail or be overloaded with other traffic.

c. Facilitates Speed in Response

Speed is the essence of a successful emergency response. Disaster situations, particularly when they involve collections, are likely to deteriorate rapidly. A good disaster plan should examine all of the park's normal procedures, should identify any built-in obstacles to quick action, and should provide for an "emergency mode" in which, as far as possible, all such obstacles are removed. For example, a conservator normally will require certain approvals from collection curators and will prepare condition reports before treating objects, perhaps even before removing them. In an emergency, such prior approvals must be waived; conservators must have the freedom to act quickly and then to report retroactively on the actions they have taken. Emergency funding sources for a conservator's assistance should be identified. In short, the disaster plan must recognize that the emergency situation has drastically changed the park's priorities and its normal ways of doing business.

d. Identifies Emergency Priorities

Most park staff will state that their priorities are to be resources preservation or visitor services or interpretation or some other activity that they and the National Park Service value. One indication of a good disaster plan is its recognition that the normal priorities of the park and of its museum must be set aside in favor of the emergency priorities. The first is the protection of life. The second--no matter what the park's normal priorities may be--must be the safety of the collection. Adhering to those

priorities may require some quite fundamental redirection of park staff members. A good disaster plan will provide that redirection firmly and clearly. Competition for budgetary and personnel resources is not a luxury in an emergency. If the emergency priorities of life safety and collection protection are to be met, all of the park's resources must be placed immediately, totally and noncompetitively at the disposal of those acting to save the collection. When the park is responsible for other resources, such as historic structures, monuments, and archeological sites, that are considered to be equal in value and significance to the museum collection, the disaster plan must clearly define a set of priorities to follow when allocating finite resources after a disaster. Curatorial staff must be aware that other park cultural resources may be considered more important than the museum collection. Staff should be prepared to accept lower priorities for protection of the collection in certain circumstances. However, it is equally important for the curatorial staff to know--through the emergency plan--what those circumstances may be and what decisions may have to be made.

e. Identifies All Needed Resources

The plan should identify all the resources--human and material--on which the park may need to call for assistance. It should establish both routine and alternative channels for calling on those resources when the need arises. The regional office and all outside local agencies--municipal, county, state, etc.--whose assistance may be required should be consulted during planning to ensure that all parties to the plan understand their respective roles, and they should be supplied with copies of the plan when it is finalized and whenever it is revised. Essential material resources also should be identified and small quantities of non-perishable supplies, such as plastic sheeting, paper towels, blotting paper, duct tape, and squeegees, should be stockpiled. However, perishable materials, expensive equipment, and larger quantities of non-perishable supplies need not be stockpiled. Instead, commercial suppliers who have them in stock should be identified and arrangements made for immediate delivery when they are needed. Parks should work with the Regional Contracting Officer to use Blanket Purchase Agreements to facilitate purchasing supplies/equipment in an emergency. Such resources also could include alternative storage spaces, bulk cold storage and commercial freezing facilities or, better still, freeze-drying facilities if possible. Section F, "Guide to Emergency Supplies and Equipment," provides some idea of what kinds of materials should be available for emergency situations.

f. Acknowledges Sources of Assistance

Maintain regular and friendly contacts with local and state public emergency service agencies and any other external organizations that may help you in a crisis. Understand their priorities, needs, and limitations and make certain that they understand the

park's. The responsibilities and constraints of cultural institutions are often profoundly different from those of other institutions, and it is unlikely that the publio emergency services agencies will know the park's needs, unless they are informed of them before the disaster happens.

9. <u>Train Park Personnel in How to Use the Plan</u>

The effectiveness of the plan during an actual disaster will depend upon prior training of all personnel who have any responsibility for plan execution and upon regular testing of the plan. Training has the following three purposes:

a. To guarantee that every employee will react with confidence and without hesitation in an emergency.

b. To ensure that each employee on whom execution of the plan depends will know his or her job effectively and without panic.

c. To ensure that each responsible employee has acquired the knowledge and skills to function responsibility and effectively and without panic.

Focus training on actions to be taken as a disaster develops and on response and recovery measures. Training topics include: command and control, warning and emergency communications, evacuation and roll-call arrangements, emergency first-response actions, response and recovery priorities, relocation of collections, and procedures for summoning outside assistance and resources. Training probably should not begin until the plan has received at least preliminary approval in the regional office.

10. <u>Test the Plan</u>

Test the plan by planning, scheduling, and conducting periodic exercises to determine if it will function as intended. Tests can be as simple as an occasional fire drill or as complicated as a simulated earthquake or flood with widespread damage and human casualities. At a minimum, testing of plans for protecting museum collections should be done when the overall park EOP is tested. Revise the plan whenever a test reveals deficiencies. The plan should be tested first while it is in draft, before it is submitted for approval to the regional office, though at that point the test can be only a walk-through or table-top exercise if a full-scale simulation would not be practical. The plan also should be tested, along with the park's EOP, whenever local or state emergency services agencies conduct a test or exercise involving the park.

11. <u>Evaluate the Plan</u>

Evaluation takes place whenever the plan is executed under actual disaster conditions. Good written and photographic records should be kept of what happens during plan execution. The plan and the

performance of all participants in disaster operations should be subjected to a candid critique as soon as possible after operations have returned to a semblance of normality. Feedback should be encouraged from all involved persons through written reports, interviews, and group meetings. Observation of what kinds of damage actually happened (possibly different from what was believed would occur) will permit revisions to the plan and will permit mitigating actions to be implemented so that the museum becomes more resistant to similar events in the future. It is particularly important to evaluate the performance of and support provided by outside sources of assistance, such as neighboring museums, volunteer groups, utility companies, moving and storage companies, and conservators who may have been brought in.

12. Keep the Plan Current

The purpose of evaluation is, of course, to help keep the plan current. Most of the opportunities to revise a plan will come after weaknesses in it have been identified during tests and actual crises. However, those are not the only times that a plan can be or should be revised. All plans get out of date: people retire or change jobs, telephone numbers change, new equipment is purchased and old equipment is scrapped, companies go out of business, and agency responsibilities change. Keeping a plan up to date is difficult, unless there is a high frequency of emergency incidents and the plan thus gets a lot of use. State and local emergency management agencies generally agree that plan updating is one of the biggest problems, if not the single biggest problem, in contingency planning. There is no ready, 100 percent foolproof solution to this problem, so overkill is suggested. Use as many of the following techniques as possible--preferably all of them--and then think up some additional ones.

a. Establish a regular review period, preferably every three or six months, never less than annually. The park curator should perform this review, either personally or in conjunction with the ranger staff.

b. Report the results of the review to the person responsible for updating the plan and, as appropriate, to park management.

c. Include a "Record of Amendments and Changes" sheet in the front of the plan. When changes are sent out, people with copies of the plan should enter the following on the sheet in their copy: Date, Pages Affected, Nature of Change.

d. In the plan, include instructions on where to report needed changes; instruct persons who have copies of the plan to report any needed changes or suggested revisions to whomever is responsible.

e. Sections of the plan that are subject to frequent revisions, such as telephone and duty rosters, should be easily replaceable; they can be in separate sections or appendices or the entire plan can be looseleaf. Each new or replacement page should bear the date so that a copy of the plan can be checked quickly to determine if it is current. Use headers for the sections. Refer to NPS-1, <u>Directives Management Guideline</u>, for suggested headers.

The person responsible for keeping the plan updated should do the following:

- Maintain a list of plan holders.

- Periodically determine if anyone in the park or outside who does not already have a copy of the plan should have one.

- Periodically check whether the telephone numbers listed in the plan are current, whether promised support equipment and services are still available, whether persons who are to be on call are still available, and so on.

- Periodically ask everyone assigned a role in plan execution to review those sections of the plan that define their responsibilities and actions to see if they are still valid. (This also is done during tests.) Also evaluate their continued ability to respond as required.

- Distribute changes as soon as they occur.

- Request changes that are sent out to be acknowledged by their recipients, such as by endorsement of a cover letter or by a return card.

- Send a periodic letter to all plan holders, even if there are no changes to issue at that time, asking that it be acknowledged. This procedure will identify whether any plan holders are no longer on the staff or involved with the plan's execution.

F. GUIDE TO EMERGENCY SUPPLIES AND EQUIPMENT

This section suggests the types of supplies and equipment that may be needed to cope with a natural disaster or other event that causes damage to the museum or to its contents. No park will ever need to stock the full range of supplies and equipment listed here. Each park should acquire only those items that are likely to be of benefit depending on the kinds of emergencies and types of damage that have been anticipated. On the other hand, this list does not pretend to be all inclusive. Almost certainly, the park staff will find during the planning process that they expect to need items that have not been listed. This list is intended only as a guide.

Items listed here do not necessarily have to be stockpiled exclusively for use in an emergency. Some of these items will be found in all parks as a matter of course. They may be diverted for use in cleanup and repair operations whenever they are needed. However, keep in mind that the items the park may be counting on to use during or after an emergency may be damaged or destroyed or rendered inaccessible by that same emergency. Therefore, those items that will be critical to the survival of the museum and that cannot be procured promptly from elsewhere after the emergency should be set aside or stockpiled in a safe place so they will be available if they ever are needed. Precautions must be taken to ensure that stockpiled emergency supplies and equipment are not pilfered or used for day to day operations.

Remember that some items (such as dry cell batteries) have a limited shelf life. Plan on replacing such items periodically so that fresh stock is always on hand in the stockpile. Include operating manuals or instructions with items of mechanical and electrical equipment in case someone not experienced with their operation is required to use them in an emergency.

The below listed items marked by an asterisk (*) are considered the most critical to have on hand in response to a fire or to other disaster events that may result in water damage.

Supplies and Equipment for Debris Removal and Cleanup

Low sudsing detergents
Bleaches
*Sanitizers (such as chloride of lime or high-test hypochlorite)
Fungicides, insecticides, and rodenticides
*Disinfectants
Ammonia
Scouring powders or other cleaners
*Rubber gloves
Brooms
Dust pans
*Mops, mop buckets, and wringers
Scoops and shovels
*Scrub brushes
*Sponges and rags or cloths
*Buckets
Squeegees
*Wash tubs or clean garbage cans
*Water hoses and nozzles
*Throw-away containers for trash
Wet/dry vacuum with accessories

Tools and Equipment for Demolition, Repairs, and Rescues

Hammers (both claw and machinists)
Wrenches (pipe, channel lock, and Vise Grips in various sizes)
Pliers (adjustable, lineman's, and needle nose in various sizes)
Screwdrivers (straight blade and Phillips in various sizes)
Special tools for tamper-resistant screws and bolts (if needed)
Wood saws
Metal saws with spare blades
Utility knives with spare blades
Wire cutters with insulated handles
Tin snips
Pipe cutter and threader
Bolt cutter
Hand drill with bits
Pry bar or crowbar (possibly small and large sizes)
Axes, including fireman's axe
Ropes
*Dollies or handcarts
Folding rules or retractable tape measures, 8′ minimum
3-ton hydraulic jack
Sledgehammer (possibly two different sizes)
Block and tackle
Pit cover hook (if applicable)
*Hydrant and post indicator valve wrenches (if there is a sprinkler or standpipe system for fire suppression)
Staple gun and staples
Ladders and stools

Construction Materials

*Plywood for covering or replacing broken windows
*Dimensional lumber for temporary framing
*Nails, screws, bolts, nuts, and assorted fasteners
*Tapes of various kinds (masking, duct, electrician's, etc.)
Glue
Twine and small rope or cord
*Plastic sheeting for protection against leaks and splashes
Binding wire

Emergency Equipment

Emergency gasoline powered electrical generator
Portable lights (if a generator will be available)
*Emergency lights with extra batteries
*Flashlights or lanterns with extra batteries
*Fire extinguishers (ABC dry chemical recommended)
Battery-operated AM/FM/short-wave radio(s) with extra batteries
Portable CB radio(s) with extra batteries
Walkie-talkie radio(s) with extra batteries
Portable public address system or bullhorn

Geiger counter and/or dosimeters
Gas masks with extra canisters
*Air breathers with extra oxygen tanks
*Resuscitation equipment
*Gasoline powered water pump (or pump which can be powered by the electrical generator) with appropriate hoses and fittings
*Extension cords, preferably equipped with ground fault interrupters

Personal Equipment and Supplies

Some of these items may be provided by the individual employees and volunteers who are to use them:

*Necessary protective clothing
*Rubber boots or waders
Hard hats
*Rubber lab aprons
*Protective masks and goggles or safety glasses
First aid kits and medical supplies
Food and food preparation equipment
Potable water
Sanitation facilities
Sleeping bags, blankets, pillows

Miscellaneous Supplies

*Boxes for packing and moving artifacts, records, books, and equipment. Record transfer boxes are the easiest to use, carry, and store. They come flat for storage and are to be set up as needed; they may be reflattened later for storage and re-use.
*Box sealing and strapping tapes
*Tissue paper, clean newsprint, plastic "bubble pak," and other such materials for packing artifacts prior to relocation.
*Marking pens, preferably indelible; include some that will write on plastic (available from the Curatorial Services Division, Harpers Ferry Office).

Miscellaneous Equipment

*Fans
*Space Heaters
*Portable dehumidifiers
*Hygrometers/psychrometers
*Photographic equipment (35mm camera, lenses, accessories, flash, film, spare batteries, etc.)
Essential office equipment (manual typewriter, pocket calculator, pencil sharpener, stapler, rulers, etc.)
Essential stationery and blank forms and other such supplies to ensure capability of minimal administrative operations

Conservation Supplies and Equipment

- Polyester (Mylar®) and polyethylene film
- *Newsprint (unprinted) in sheets
- *Polyethylene bags in various sizes (such as Zip-Loc® or produce bags)
- *Plastic garbage bags and ties
- *Thymol
- *Ethanol
- Acetone
- *Industrial denatured alcohol
- *White blotting paper
- *Silicone release paper or wax paper
- *Various sizes of thick glass or smooth Masonite
- *Weights, such as leather shot bags
- *Japanese tissue
- *Towels or clean rags
- *Clothes pins, preferably plastic
- Scissors, large and small sizes
- Sharp knives, such as X-Acto®
- Water displacement compound, such as WD-40® spray or liquid
- Waxes and dressings, as appropriate to the collection

G. GLOSSARY

Disaster: A sudden or great misfortune; unforeseen mischance bringing with it destruction of life or property. Disasters are a class of emergencies: not all emergencies become disasters, but all disasters are emergencies that have gotten out of control.

Disaster Mitigation: Preparedness planning and activities that are directed toward eliminating or reducing the probability of occurrence of a disaster or reducing the effects of unavoidable disasters.

Disaster Preparedness: Those activities that prepare a framework for organized and immediate response to disaster situations that cannot be mitigated. The purposes of preparedness are to save lives, to minimize disaster damage and effects, and to facilitate recovery. Thorough training and exercises enhance preparedness capabilities and provide a review process for identifying changes and necessary updates in plans.

Disaster Response: Those activities that provide for temporary care and relief for victims of disasters and emergencies and ensure that avoidable casualties and property damage do not occur. (Beyond a certain degree of seriousness, depending upon the type of disaster and the nature of the threatened organization, successful response to a disaster depends upon the application of resources other than or in addition to those of the affected organization, i.e., upon outside assistance or support.)

Disaster Recovery: Those activities continued until operations return to normal or to an improved level. During recovery, activities that would enhance mitigation and preparedness may be discovered and taken into account in improved planning and reconstruction.

Disaster Plan: A document that: identifies an organization's vulnerabilities to disaster; points out how some of them can be mitigated and others prepared for; details ways and means of responding to disasters that do occur; and provides a guide to the organization's ultimate recovery. Plans are a blueprint to be followed for protection of the organization's assets and integrity in face of danger.

Disaster Plan Implementation: A plan is implemented when it has been written, reviewed, revised, approved, and tested and when the park and region has done everything called for by the plan in advance of anticipated emergencies, such as acquisition of emergency supplies, training of the organization's staff, and assignment of priorities for response and recovery.

Disaster Plan Execution: A plan is executed when a disaster occurs and the Disaster Control Organization responds in accordance with the plan. In some respects, a plan also is executed when it and the Disaster Control Organization are tested through periodic exercises.

Emergency: An unforeseen combination of circumstances or the resulting state that calls for immediate action.

Emergency Operations Plan (EOP): A document prepared by a park, in cooperation with its Regional Office, to guide the staff in how to prepare for emergencies and disasters; such plans are to give special attention to protecting cultural resources from the effects of disasters and to give them high priority in recovery from any disasters that cannot be averted.

H. SELECTED BIBLIOGRAPHY

Barton, John P. and Wellheiser, Johanna G.
1985 An Ounce of Prevention: A Handbook on Disaster Contingency Planning for Archives, Libraries, and Record Centers. Toronto, Canada: Toronto Area Archivists Group.

Burr, Nelson R. (compiler)
1952 Safeguarding Our Cultural Heritage: A Bibliography on the Protection of Museums, Works of Art, Monuments, Archives, and Libraries in Time of War. Washington, D.C.: Library of Congress, General Reference and Archives Division.

Canadian Conservation Institute
May 1984 "Planning for Disaster Management: Introduction," CCI-ICC Notes, 14/1. Ottawa, Canada: Canadian Conservation Institute.

Canadian Conservation Institute
May 1984 "Planning for Disaster Management Emergency or Disaster?," CCI-ICC Notes, 14/2. Ottawa, Canada: Canadian Conservation Institute.

Canadian Conservation Institute
May 1984 "Planning for Disaster Management: Hazard Analysis," CCI-ICC Notes, 14/3. Ottawa, Canada: Canadian Conservation Institute.

Cohn, B. M.
Summer 1980 "Fire Safety in Recycled Buildings: Establishing the Level of Protection Equivalent to Code Requirements." Technology and Conservation, 5:2:40-45.

Committee on Conservation of Cultural Resources
1942 The Protection of Cultural Resources Against the Hazards of War. Washington, D.C.: National Resources Planning Board.

Conway, H. McKinley
1981 Disaster Survival. Atlanta: Conway Publications, Inc.

The Economic and Social Commission for Asia and the Pacific, the World Meteorological Organization, and the League of Red Cross Societies
1977 Guidelines for Disaster Prevention and Preparedness in Tropical Cyclone Areas. Geneva and Bangkok.

Federal Emergency Management Agency
1983 Flash Flood Awareness Packet, FEMA-35. Washington, D.C.: Federal Emergency Management Agency.

Federal Emergency Management Agency
1985 In Time of Emergency: A Citizen's Handbook, H-14. Washington, D.C.: Federal Emergency Management Agency.

Federal Emergency Management Agency
1985 Protection in the Nuclear Age, H-20. Washington, D.C.: Federal Emergency Management Agency.

Federal Emergency Management Agency
1981 When You Return to a Storm Damaged Home, DR&R-16. Washington, D.C.: Federal Emergency Management Agency.

Feilden, Sir Bernard M.
1987 Between Two Earthquakes: Cultural Property in Seismic Zones. International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), Rome, Italy; and The Getty Conservation Institute, Malibu, CA.

Fortson-Jones, Judith
May 1983 "Practically Speaking--How to Develop a Disaster Plan for Books and Records Repositories." History News. Nashville, TN: American Association of Museums.

Gere, James M. and Shah, Haresh C.
1984 Terra Non Firma: Understanding and Preparing for Earthquakes. Stanford, CA: Stanford Alumni Association.

Hensley, John R.
1987 "Safeguarding Museum Collections from the Effects of Earthquakes." Curator. New York: American Museum of Natural History.

Hopf, Peter S. (editor)
1979 "Part Two: Security from Natural Disasters." Handbook of Building Security Planning and Design, Chapters 6-8. New York: McGraw-Hill Book Co.

Jones, Barclay G. (editor)
1986 Protecting Historic Architecture and Museum Collections from Natural Disasters. Boston: Butterworths.

Keck, Sheldon (editor)
1982 Emergency Care of Museum Artifacts and Library Materials Affected by the Flood. Cooperstown, NY: New York State Historical Association.

Kemp, Toby
1983 "Disaster Assistance Bibliography: Selected References for Cultural/Historic Facilities." Technology and Conservation, Summer, 8:2:25-27.

Martin, John H. (editor)
1977 The Corning Flood: Museum Under Water. Corning, NY: The Corning Museum of Glass.

Mathieson, David F.
1983 "Hurricane Preparedness: Establishing Workable Policies for Dealing with Storm Threats." Technology and Conservation (Summer), 8:2:28-29.

Matthai, Robert A. (editor)
1979 Protection of Cultural Properties During Energy Emergencies and Energy Conservation and Historic Preservation. New York: Arts/Energy Project.

Morris, John
1986 The Library Disaster Preparedness Handbook. Chicago: American Library Association.

Myers, James N. and Bedford, Denise D. (editors)
1981 Disasters: Prevention and Coping. Proceedings of the Conference, May 21-22, 1980. Stanford, CA: Stanford University Libraries.

Noblecourt, Andre F.
1958 Protection of Cultural Property in the Event of Armed Conflict. Museums and Monuments Series 8. Paris: UNESCO.

O'Connell, Mildred
1983 "Disaster Planning: Writing and Implementing Plans for Collections-Holding Institutions." Technology and Conservation (Summer), 8:2:18-24.

Pichard, Pierre
Emergency Measures and Damage Assessment After an Earthquake. No. 6 in a series "Studies and Documents on the Cultural Heritage." Paris: UNESCO.

Preservation Committee, St. Louis Regional Library Network
1982 St. Louis Area Resources for Library Conservation and Disaster Preparedness: A Bibliography and Checklist. St. Louis, MO: St. Louis Regional Library Network.

Reitherman, Robert (Scientific Services, Inc.)
1983 Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide. Van Nuys, CA: Southern California Earthquake Preparedness Project.

Rhodes, Barbara J. (compiled by)
1988 Hell and Highwater: A Disaster Information Sourcebook (METRO Miscellaneous Publication No. 35). New York: METRO New York Metropolitan Reference and Research Library Agency.

Schmidt, J. David
1985 "Freeze-Drying of Historic/Cultural Properties: A Valuable Process in Restoration & Documentation." Technology and Conservation (Spring), 9:1:20-26.

Society of American Archivists
1982 Disaster Prevention and Preparedness (Problems in Archives Kits series). Chicago: Society of American Archivists.

Solley, Thomas T.; Williams, Joan and Baden, Linda
1987 Planning for Emergencies: A Guide for Museums. Washington, D.C.: Committee on Museum Operations, Association of Art Museum Directors and American Association of Museums.

Upton, M. S. and Pearson, C.
1978 Disaster Planning and Emergency Treatments in Museums, Art Galleries, Libraries, Archives, and Allied Institutions. Canberra, Australia: The Institute for the Conservation of Cultural Material, Inc.

Waters, Peter
1975 Procedures for Salvage of Water-Damaged Library Materials. Washington, D.C.: Library of Congress.

I. ENDNOTES

1. This chapter is similar to material published by the author in the book Protecting Historic Architecture and Museum Collections from Natural Disasters edited by Barclay G. Jones (1986), pp. 2-11 through 2-30. The material is derived from early manuscripts written by the author for use in the National Park Service.

CHAPTER 11. CURATORIAL HEALTH AND SAFETY ISSUES

A. INTRODUCTION TO CURATORIAL HEALTH AND SAFETY

Similar to all work environments, the museum may pose potential health and safety hazards. Curators and conservators use a wide variety of materials in collections management and care, including toxic and flammable solvents, pesticides, fumigants, and preservatives. Working with such materials exposes staff to occupational hazards. Applying such materials to objects can make the objects dangerous for persons to handle (e.g., arsenic on mammal skins, object outgassing a fumigant). In addition museum collections may contain objects with inherent vices that pose hazards to the safety of staff and visitors (e.g., cellulose nitrate negatives, unexploded ordnance).

This chapter identifies the occupational health and safety hazards that are unique to the museum work environment and provides guidance to assist park staff in insuring a healthful and safe curatorial environment. Refer to Appendix H for laws, regulations, policies and guidelines on the NPS health and safety program.

1. General Categories of Occupational Hazards

The four general categories of occupational hazards are listed below. All of these categories may exist in the museum work place.

a. Chemical Hazards: include any chemicals or substances that present a potential physical or health hazard source when used. These agents can be in the form of liquids, mists, vapors, dusts, fumes, gases and solids.

b. Physical Hazards: include radiation, atmospheric variations (e.g., air pressure/temperature changes), and oscillatory vibrations (e.g., noise and vibrations).

c. Biological Hazards: include exposures to bacteria, fungi, viruses, parasites and allergic reactions to plant and animals.

d. Ergonomical Hazards: involve concerns with the design and the selection of a work environment, and tools and equipment that produce the least strain or stress on the worker with the optimum efficiency.

2. Overview of Occupational Health Concepts

A hazardous substance is any material that can harm the body if it is absorbed in large enough quantities over a period of time. NPS-50, Loss Control Management Guideline provides a more complete definition of a hazardous material: "a chemical or mixture of chemicals that is toxic, highly toxic, an irritant, a corrosive, a strong oxidizer, a strong sensitizer, combustible, flammable, extremely flammable, dangerously reactive, pressure-generating, or otherwise may cause substantial personal injury or substantial illness during or as a direct result of any customary or reasonable forseeable handling or

use." Each hazardous material, or group of materials, has specific toxic effects. The term toxicity is used to describe a material's capacity to produce injury to the human body. The higher the toxicity of a substance the smaller the quantity of this substance is needed to cause injury. Hazardous substances can cause damage at the point of contact with the body or they may damage several different body organs.

Health effects can be of a chronic or of an acute nature. In the workplace, a person may absorb only small amounts of a hazardous substance at a time. These quantities may seem insignificant; however, with daily exposure over a period of years, this material can accumulate in the body. Health effects that result from this slow accumulation are called <u>chronic effects</u> and include respiratory problems, cancer, birth defects, and damage to the heart, liver and kidneys.

There are specific instances when workers may be accidently exposed to large quantities of a hazardous substance. Symptoms of illness that result from such an exposure are called <u>acute effects</u> (e.g., burning eyes, dizziness, and light-headedness).

The exposure limit for a substance is the highest exposure level recommended in a work area when workers are in that area without any special protection. It is measured by two methods: permissible exposure limit (PEL) and threshhold limit value (TLV). The PEL, established by the Occupational Health and Safety Administration (OSHA), is the concentration and time of exposure that cannot be exceeded. This standard is enforceable by Federal law. Each substance has a determined ceiling for concentration and time of exposure. The TLV is a recommended level (not enforceable by law). It is a guideline based on scientific information derived from current studies of exposed animals. Results of these studies are issued annually by the American Conference of Governmental Industrial Hygienists (ACGIH). The TLV equals or is more stringent than the PEL. The National Park Service uses 50% of the PEL limit as an action level. If the concentration of the contaminant in the air of the work area is at or above 50% of the PEL, but below the PEL level, some action must be taken to monitor the exposure level and to reduce the concentration through engineering controls. When engineering controls are not feasible, workers may need to rely on administrative controls or personal protective equipment.

Many hazardous materials have good initial warning properties that signal exposure to a potential injury (e.g., odor; burning eyes; skin, nose and throat irritation; breathing difficulty). However, after prolonged exposure, olfactory fatigue may set in and the employee will no longer be able to smell the contaminant. Other hazardous materials provide little or no warning. They can cause harmful effects when they are present in quantities too small to be detected by odor or by other unpleasant symptoms. <u>Therefore, it is important to identify all materials used in the workplace</u>.

There are three ways in which the body absorbs substances. These routes of absorption are through the skin, lungs, and mouth.

Skin Contact. Healthy, undamaged skin usually provides an effective barrier against the absorption of many hazardous substances. Many hazardous substances can dissolve or destroy the skin's protective layer. Punctures, scrapes, and cuts also increase the risk of absorption. Some agents are absorbed faster through the skin and can cause systemic damage. The common warning properties are burning, pain, redness, or irritation.

Inhalation. Hazardous substances are very often airborne (e.g., dusts, mists, fumes, vapors, gases). Such materials, when inhaled, are readily absorbed into the blood stream and are distributed to all parts of the body. Some materials cause damage to the lungs, others pass into the blood stream without harming the lungs. Common warning signs include coughing, a burning sensation, heaviness in the chest, wheezing or difficulty in breathing.

Ingestion. Small quantities of a toxic substance can be unknowningly absorbed into the gastro-intestinal system on food, drink, or on contaminated hands.

The factors that determine the degree of a health hazard from a given substance are as follows:

- Toxicity of Substance

- Amount of Substance

- Duration (e.g., length and frequency) of Exposure

- Protective Measures Used (e.g., ventilation, respirators, gloves)

- Susceptibility (e.g., condition of employee's health at time of exposure)

- Conditions Existing at Time of Exposure (Temperature, air flow, and humidity affect the dispersion of a hazardous substance, its availability for absorption, and the amount and speed of absorption.)

The concept of <u>breathing zone</u> is important. Curatorial staff work in close proximity to objects. This daily work very often is conducted in the vicinity of a person's nose and mouth. The breathing zone is the part of the work environment that is in close proximity to where a person performs the normal respiratory function. The concentrations of airborne contaminants in this zone is important for determining a person's exposure to a substance that may be toxic via inhalation.

3. <u>Curatorial Health and Safety Program Goals</u>

The ultimate goal of this program is to reduce or eliminate occupational illness and injury. The Servicewide Loss Control Management Program, outlined in NPS-50, <u>Loss Control Management Guideline</u> provides the appropriate framework to achieve this goal. A park's curatorial health and safety program should build on this guidance document. The goals of a park's curatorial health and safety program are as follows:

a. Recognize and identify the hazards.

b. Evaluate the hazards.

c. Reduce or eliminate the hazards to the extent possible.

Park curatorial staff should work closely with park and regional safety specialists and the Regional Curator to ensure that health and safety issues in the museum workplace are addressed in the park's Loss Control Management Program. To ensure that a park unit is aware of curatorial health and safety issues, it is recommended that the curator be a member of the park's Occupational Safety and Health Committee. Refer to NPS-50, <u>Loss Control Management Guideline</u>, Appendix D for guidance on this committee.

4. <u>Categories of Museum Health and Safety Hazards</u>

Health and safety hazards in the museum can be divided into the following general categories:

a. Hazardous Chemicals/Materials Used in Collections Care

b. Hazardous Objects in the Museum Collection

c. Careless Lifting and Carrying Techniques

B. METHODS FOR CONTROLLING IMPROPER EXPOSURE TO HAZARDOUS SUBSTANCES

Controlling improper exposure to hazardous substances in the work place includes the following measures:

- Limiting the use of hazardous materials
- Installing proper ventilation
- Wearing appropriate personal protective equipment
- Practicing good housekeeping and personal hygiene
- Storing, handling, and labelling hazardous materials in an appropriate manner
- Disposing of hazardous materials properly.

1. Limiting the Use of Hazardous Materials

    a. Where possible, use a less hazardous material, or use a different method. For example, mineral spirits can be substituted for benzene; water based paints and inks can be substituted for nic solvent base paints and inks. An IPM monitoring program, can be substituted for traditional use of repellant insecticides (e.g., paradichlorobenzene or Vapona?).

    b. Limit the time of exposure to hazardous substances.

    c. Close all containers of chemicals when they are not in use.

    d. Designate a specific area within the curatorial workspace for working with hazardous substances and materials. This practice confines the substances to a small area and facilitates clean-up.

    e. Provide waste receptacle with lids for disposal of toxic materials (e.g., especially evaporative solvents).

2. Installing Proper Ventilation

    Ventilation is the key engineering control for protecting staff from the effects of hazardous substances. Proper ventilation should be a high priority for the curatorial workspace. The rules for proper ventilation of a workspace are as follows:

    - Air in the workspace should flow away from the breathing zone of each worker to non-occupied area of building or to the exterior of the building.

    - Pull contaminated air out of the workspace with an exhaust fan. A fan used to blow air out of the workspace will only succeed in dispersing the contaminate within the workspace.

    - Locate the ventilation system's exhaust opening in close proximity to the source of the contaminates. Move the work to the exhaust area.

- Promote maximum effectiveness of the exhaust system by preventing cross drafts from interrupting the direct outward flow of contaminated air.

- Ensure that the air exhausted from the workspace is replaced by a fresh supply of air to avoid negative pressure. Negative pressure reduces the ability of the exhaust system to remove contaminates.

- Ensure that exhaust outlets to the outside are located away from air-intakes that would draw the contaminate back into the workplace or emit the contaminate in an area where people, animals, birds, and vegetation may be affected. Allow for sufficient stack height to preclude contaminants from settling on the roof. Consult a ventilation engineer for specific requirements.

- Avoid polluting the surrounding community with the contaminated exhausts. The level of environmental pollution from exhausts depends on the toxicity and concentration of the substance being vented.

The two basic types of ventilation systems are general or dilution ventilation and local exhaust ventilation.

<u>General or dilution ventilation</u> is designed to keep staff comfortable by heating, cooling, and controlling the air's moisture content. It can be used to lower the concentration of a hazardous material to an acceptable level and then remove it from the workspace. <u>Local exhaust ventilation</u> directs the air in a way that allows the system to capture the substance at the generation source and carry it away from the worker's breathing zone. This type of ventilation has a wide range of applications in the museum workspace. It is very effective in removing substances of moderate to high toxicity by using a system of hoods, ducts, air cleaners, and fans. The primary advantage of local exhaust ventilation is that <u>it is designed to remove air and any contaminates</u> (e.g., gases, vapors, fumes, dusts) <u>from the breathing zone of staff</u>.

A well-designed exhaust hood is the primary and most effective method for removing high to moderate concentrations of airborne hazardous materials. The book <u>Ventilation, A Practical Guide</u>, listed in Section H of this chapter, provides detailed guidance on ventilation systems, including the criteria for designing an exhaust hood system. Refer to Appendix H, Section C of this handbook for the advantages and disadvantages of these types of ventilation. Work with the Park and Regional Safety Managers, the Regional Curator, and the park's maintenance staff to evaluate the effectiveness of, and if necessary, to improve ventilation in the curatorial workspace.

If low concentrations of hazardous materials are used in the work-place, portable ventilators may be a practical solution to proper ventilation. A fume or air scrubber can be very effective in controlling low concentrations of organic chemicals. These portable

air filtration units draw air through a charcoal absorption filter with an internal fan. The filtered air then is discharged back into the workspace. This type of equipment has the advantage of not creating a negative pressure in the space's general ventilation system and is less expensive than a hood exhaust system. The one disadvantage of this type of equipment: the activated charcoal filter must be periodically changed to prevent overloading and breakthrough. Small desk fans can be used to quickly move air with low levels of hazardous contaminates away from an employee's breathing zone. Refer to Appendix H for sources of ventilation equipment.

3. Wearing Appropriate Personal Protective Equipment (PPE)

NPS-50, Loss Control Management Guideline states the following NPS policy relevant to personal protective equipment: "personal protective equipment shall never be considered the primary source of protection. PPE's are to be used only when other management controls (e.g., ventilation, adopting an alternative procedure or substance, limiting the exposure time to a substance) are not possible or feasible."

The equipment designed to protect employees from exposure to hazardous substances includes respiratory devices, eye and face protection devices, and protective clothing. **It is important to remember that there is no personal protective equipment designed for universal use.** Selection of personal protective equipment must be based on the specific hazardous substances/materials being used by the employee. Material Safety Data Sheets provide specific information about the appropriate types of protective equipment to be used with a hazardous substance. Refer to Section D of this chapter for a discussion of Material Safety Data Sheets.

a. Respiratory Protective Devices

In accordance with OSHA's CFR 1910.134, respiratory equipment is used when engineering controls are not feasible (e.g., temporary work in a dusty attic or basement) or in an emergency (e.g., trapped in a space where the supply of oxygen becomes insufficient). The two general categories of respirators include: air supplied devices and air-purifying devices.

1) Air Supplied Respirators

These devices are designed to bring a fresh air supply to the wearer from a pressurized tank or compressor. These complex and expensive types of respirators have minimal application to the curatorial workplace.

2) Air-Purifying Respirators

These devices are designed to be used by the wearer to draw air from the workplace through filters or cartridges to purify it

before it is inhaled. This type of respirator may be made out of paper, plastic, neoprene, or silicone materials. The material depends on the application. <u>Air-purifying respirators should not be used as a substitute for proper ventilation</u>.

b. Criteria for Selecting a Respirator

Use the following criteria to select a respirator:

- Proper ventilation is the primary method for ensuring a working environment safe from toxic airborne substances. If an employee is to be required to wear a respirator in the workplace, then a detailed medical physical is required by OSHA to verify that the employee is capable of breathing through a respirator with no risk to the individual's health.

- Specific selection of a respirator should be carried out in consultation with the Park Safety Officer. A selected respirator must have been approved by the National Institute for Occupational Safety and Health (NIOSH).

  A leak-tight seal between the face and respirator face piece is essential. Facial hair that interferes with this seal is prohibited by law. The law also requires that the employee be fit tested for the respirator and be trained on the use and maintenance of the respirator. Consult the park Safety Officer for fit test procedures.

  - Consider the type of filtration required. If the air contaminants are particulate (e.g., silica, asbestos, dust), use a respirator approved for this purpose. If the contaminates are in vapor form (e.g., nitrocellulose, acetone), use an organic vapor respirator. Air-purifying respirators use two types of purifying material - a filter or a chemical cartridge. Different filtering materials are required to trap different particulates. For example, a filter designed and approved only for <u>silica</u> dust will not protect a person from solvent vapors. Chemical cartridges are designed to trap chemical gases and vapors. Different chemical cartridges are required to trap different vapors. Consult the applicable Material Safety Data Sheet for the specific type of respirator required.

  - Consider comfort to the wearer. Respirators may be uncomfortable to the wearer after a few hours. Some of the materials may be more irritating to the wearer than the presence of the contaminants.

  - Consider the cost of respirators. Some respirators (e.g., paper) are disposable. Others are not and require periodic maintenance and cartridge replacement.

  - Refer to Appendix H for sources of respirators.

c. Gloves

In selecting gloves, consider the chemicals to be handled. There are many types of gloves manufactured to protect against different types of materials. The permeability rate of a glove is the most important characteristic to consider when selecting a glove. For example, gloves made from butyl offer the best protection from acetone. Properly maintained butyl gloves may be used over 17 hours before requiring replacement. Neoprene gloves only provide 10 minutes of protection from acetone before the chemical penetrates to the skin. Wear latex gloves when handling natural history specimens. The Material Safety Data Sheets for each material should provide the specific types of glove recommended for protection. Refer to Appendix H for sources of gloves.

4. Practicing Good Housekeeping and Personal Hygiene

Establish a routine program for cleaning floors and work surfaces. Ensure that filters in ventilation system are changed periodically. Clean up spills of any chemicals immediately. Smoking is prohibited by policy in spaces housing museum collections. Do not allow eating in the curatorial work space. After working with objects, wash hands before eating or leaving the job. Take special note of personal habits (e.g., biting nails, chewing on pencils).

5. Storing, Handling, and Labelling Hazardous Materials in An Appropriate Manner

a. Store all chemical materials used in collections care in an approved, dedicated space and only with compatible materials. Never store these materials in the same space with the museum collection.

b. Store large quantities of flammable and combustible materials in special cabinets that meet OSHA and NFPA specifications. Refer to Appendix H for sources of these cabinets.

c. Ensure that all containers are labelled with their contents. Post appropriate warning signs in the storage area. Refer to Section C of this chapter for guidance on labelling.

d. When not being used, ensure that all chemical containers are properly sealed.

e. Wear appropriate personal protective equipment when using chemical materials.

6. Disposing of Hazardous Materials Properly

A hazardous waste is defined as any solid, liquid or contained gaseous material that is no longer used, and either is recycled, discarded, or stored until there is enough of the material to warrant

treatment or disposal. The regulations implementing the Resource Conservation and Recovery Act (RCRA) of 1976, administered and enforced by the Environmental Protection Agency, provide four lists of hazardous wastes that have been identified to be harmful to health. The materials used in curatorial work that are considered hazardous waste include preservatives, formaldehyde, pesticides, and solvents.

Under the Federal Hazardous Waste Management Program, different rules apply at different times, depending on the amount of hazardous waste generated in a given month. Park curatorial staff should work closely with the Regional Hazardous Waste Coordinator on the disposal of hazardous materials, including empty containers.

All hazardous waste must be disposed of in accordance with RCRA requirements. There are requirements for the amounts of substances and for storage duration. For a detailed explanation, obtain a copy of the EPA publication listed in Section H of this chapter, Understanding the Small Quantity Generator Hazardous Waste Rules: A Handbook for Small Business for Guidance.

C. HAZARDOUS CHEMICALS/MATERIALS USED IN COLLECTIONS CARE

1. Solvents and Preservatives

There may be numerous hazardous substances in curatorial and conservation work spaces. Paints, varnishes, insecticides, cleaning materials, preservatives, and adhesives may contain toxic, flammable, or reactive materials. Some of the common hazardous solvents include acetone, kerosene, turpentine, methyl alcohol, mineral spirits, toluene, and xylene. Mineral spirits, V.M.&P.®, and Stoddard® are often used in cleaning wood furniture. The clear and white lacquer used by the NPS as a base and protective coating for catalog numbers may contain toluene and/or isobutyl acetate. The solvent for the new lacquer is less toxic but still contains flammable acetone. In natural history collections, hazardous chemicals, including formaldehyde and ethyl alcohol, are used in preserving wet specimens. The book Rapid Guide to Hazardous Chemicals in the Workplace (listed in Section H of this chapter) provides a quick and ready reference of the properties and harmful health effects of 700 common materials.

2. Fumigants and Pesticides

Traditional chemical methods used by museums to control biological infestations in collections have been fumigation and the topical application of pesticides to objects and specimens. Fumigation is the technique of introducing a toxic gas into a fixed space that contains objects. Fumigants used on museum collections include dichlorvos (DDVP, Vapona®), napthalene (moth balls), paradichlorobenzene, methyl bromide, sulfuryl flouride (Vikane®), thymol, and ethylene oxide (EtO). The pesticides arsenic and mercuric chloride have a long history of topical application to ethnographic objects and natural history specimens. These pesticides and their residuals remain extremely active for long periods of time after their initial application. **All specimens collected prior to 1970 should be examined for evidences of these pesticides before being handled.** Today, arsenic and mercuric chloride are no longer approved for use with museum collections. The pesticide DDT, once used in museums, was banned in the early 1970's.

All fumigants and pesticides are hazardous chemicals. They are toxic to humans and in many cases are flammable or explosive. The use of fumigants and pesticides in park museums has been common for several years. However, recent trends in the museum field indicate that these chemicals, including vapona and paradichlorobenzene crystals, are health hazards. Refer to Chapter 5, "Biological Infestations" for detailed guidance on implementing an Integrated Pest Management (IPM) Program in park museum spaces. From a curatorial health and safety perspective, the goal of IPM is to **reduce the amount of chemicals used in collection areas because pesticides pose a health risk for staff and visitors.**

a. Health Concerns

Fumigants and pesticides pose serious health risks to park staff and visitors. Consequently, the Federal Insecticide, Fungicide, and Rodenticide Act of 1972 as amended, permits the use of only those formulations that have received an Environmental Protection Agency (EPA) registration number. This law prohibits using these registered products for any purpose or in any manner not specified on the label or in accompanying instructions. The labels and Material Safety Data Sheets (MSDS) contain vital health and safety information. A pesticide's label also bears a signal word that indicates its relative toxicity in diminishing order. Fumigants and pesticides have the following toxicity categories: DANGER; WARNING; and CAUTION. If a chemical has more than one hazard, the signal word corresponding to the category of its greatest hazard is used. The category POISON is only used for highly toxic chemicals.

Refer to Appendix H, Section E for a list of fumigants commonly used in museums and pertinent health and reactivity information about them. The NPS Conserve O Gram series is used to update health and safety information about these materials. The fumigants ethylene oxide and paradichlorobenzene are discussed below.

b. Ethylene Oxide (EtO)

Ethylene oxide is a fumigant fungicide and insecticide that has been used to sterilize hospital instruments, fumigate some imported foods, and in museums, to fumigate books and archival materials, furs, textiles and furniture. In recent years, ethylene oxide safety standards have grown increasingly more restricted and many museums have cut back or suspended its use. Increasing awareness of associated health risks has resulted in the current strict standards for use established by OSHA in June 1984. These standards are available in 29 CFR 1910.1047, which became effective in 1985. Refer to NPS Conserve O Gram 3/15, "Ethylene Oxide Health and Safety Update" for specific health related information on this fumigant.

The OSHA standard covers monitoring and record keeping for staff exposure, designating and controlling access to areas of use, engineering requirements for chambers, establishing safe work practices, establishing a written compliance program if exposures are above the permissible exposure level, use of appropriate respirators and personal protective equipment, medical surveillance programs, and communication of EtO hazards to staff. This standard applies to all institutions using the chemical as a fumigant and to all persons handling objects that have been fumigated with EtO, thus covering all on-site and contract fumigation.

The two primary sources of exposure to EtO are the operation of a fumigation chamber and the release of residual fumigant from treated objects. EtO can be entrapped in museum objects, especially those materials with a high fat content (e.g., leather), and in containers (e.g., document boxes, cardboard tubes). Objects and containers can continue to emit gaseous EtO for a considerable length of time following treatment. Thus, while monitored levels may be within an acceptable range following fumigation and aeration, the levels may gradually rise again, particularly in storage areas and when objects are enclosed. Park staff must insure that all materials fumigated on-site or on contract, are properly aerated, and must then continue to monitor and record EtO levels in close proximity to fumigated objects and within closed containers.

National Park Service units must not use ethylene oxide on museum objects unless an alternative solution cannot be found. The permissible exposure level of one part per million clearly indicates the extreme toxicity of this chemical. Meeting the required standards in equipment use, monitoring, and long-term medical surveillance is both costly and labor intensive.

Any park considering EtO fumigation either on-site or on contract must obtain approval from the WASO IPM Coordinator via the Regional Safety Manager and the Regional IPM Coordinator, prior to obtaining the chemical or issuing the contract. Parks must acquire a copy of 29 CFR 1910.1047 (available from the Regional Curator), and ensure that all standards are strictly adhered to. For on-site fumigation, all the engineering controls and prescribed work practices must be in full compliance with the standard. For contract fumigation, parks must ensure that treated materials have been adequately aerated to reduce outgassing of residual EtO. Contracts that call for the use of EtO, must require the vendor to conduct air sampling. and furnish, in writing, adequate information about the amount of aeration provided and air sample readings taken.

Parks must prominently mark the exterior of all storage cabinets containing objects that have been treated with EtO, and must also obtain data sheets on monitoring devices and on controlling exposure to EtO. These sheets are produced by the Center for Occupational Hazards (COH), 5 Beekman Street, New York, NY 10038 (Telephone: 212/227-6220), and are available from the Curatorial Services Division, WASO.

c. Paradichlorobenzene (PDB)

Paradichlorobenzene (PDB) traditionally has been used in museum collections primarily as a moth repellant and inhibitor of mildew and other fungi. It is not uncommon to walk through a museum storage space and smell the pungent odor of this fumigant. Like all fumigants, this material is toxic to humans. The danger with this material has been its ongoing use as a repellant material and

the chronic (long-term) effects of this material on staff. Refer to NPS Conserve O Gram 3/14 for specific health related information on this fumigant.

Because of potential health effects, paradichlorobenzene must not be used routinely as a repellant. Monitoring for insect and microbiological infestation, as part of the Integrated Pest Management Program, is the preferred method for reducing the risk of biological damage to collections.

If PDB is the recommended chemical approach to dealing with a particular infestation, precautions must be taken to reduce human exposure to this fumigant. Use this material only in a tightly sealed museum specimen cabinet. Staff should not work in areas where the characteristic odor can be detected. The staff person qualified to apply this material must be certified to use pesticides. The cabinet must be identified with a warning label. Before opening the cabinet, the person must wear a full-faced respirator with black color-coded organic vapor canister.

d. Use of Fumigants and Pesticides in Museum Collections

Use of any fumigant or pesticide to control biological infestation must be in full accordance with the Department of the Interior Manual, 1981, NPS Management Policies (Dec 88), and the Natural Resource Management Guideline, NPS-77. Obtain a copy of the appropriate section of NPS-77 and become familiar with the procedures outlined for pesticide use.

Fumigants and pesticides pose a risk to both museum objects and to staff and visitors. When a chemical control method is determined to be the only effective approach to a problem, the curatorial staff should follow the procedures outlined in Chapter 5, Biological Infestations, if the objects will be treated at a non-NPS site. If EtO is the prescribed fumigant, staff must ensure that contractors comply with all existing OSHA standards. If the material is to be used at a location within the park, the staff is required to comply with procedures outlined in the Natural Resource Management Guideline, NPS-77. A summary of these procedures is as follows:

1) All pesticides (including paradichlorobenzene and dichlorvos) must be applied by or under the direct supervision of a certified pesticide applicator. NPS employees must be certified by an NPS approved training program. Non-NPS personnel must possess valid certification from the state in which the park is located.

2) Approval for using a chemical pesticide must be obtained from the Regional IPM Coordinator in consultation with the Regional Curator and the WASO IPM Coordinator. In most cases, approval is obtained by telephone. The steps for obtaining this approval are as follows:

a) Park Curator:

- Contacts park's IPM Coordinator and Regional Curator
- Provides information required to complete the Pest Control Program Report Form 10-21A. Figure 11.1 illustrates this form.

b) Park IPM Coordinator:

- Contacts Regional IPM Coordinator and provides required information.

c) Regional IPM Coordinator:

- Consults with the Regional Curator to ensure that pesticide to be used is appropriate.
- Ensures that non-chemical alternatives are not available, the proposed fumigant is currently registered for its proposed use, and that proposed project conforms to NPS and USDI policies.
- If in concurrence, contacts WASO IPM Coordinator for final project approval.

d) WASO IPM Coordinator:

- Contacts Regional IPM Coordinator within five working days with a decision.
- If project is approved, sends written approval of project to the Region.

FORM 10-21A
(REV. 11/83)

UNITED STATES DEPARTMENT OF INTERIOR
NATIONAL PARK SERVICE
PEST CONTROL PROGRAM REPORT

TARGET PEST:

PRODUCT NAME:

EPA REG. #:

ACTIVE INGREDIENT:

% or #/G (/)
ACTIVE INGREDIENT:

MIX OF PRODUCT
WITH DILUENT:

PRODUCT USAGE RATE:

PRODUCT AMOUNT USED
PER APPLICATION:

METHOD OF TREATMENT:

FORM APPLIED:

AREA OR UNITS TO
BE TREATED:

NUMBER OF SITES:

DESCRIPTION OF SITES:

NO. OF APPLICATIONS :

AMT PRODUCT USED TOT:

REGION:

YEAR:
ORGANIZATION:
PROJECT:
(e.g., YELL-84-01)

PURPOSE:

SEASON OR PERIOD
OF APPLICATION:

AREAS TO BE AVOIDED:

AREAS TO BE TREATED
WITH CAUTION:

PRECAUTIONS:

USE OF TRAINED OR
CERTIFIED PERSONNEL:

MONITORING:

PERSON TO CONTACT:

OTHER REMARKS:

SIGNATURES OF APPROVAL

PARK:________________ DATE:_____

REGION:______________ DATE:_____

Figure 11.1. Pest Control Program Report Form 10-21A

e) Regional IPM Coordinator:

- Informs park staff of WASO decision.

f) Park IPM Coordinator:

- Works with curatorial staff to ensure that fumigant is safely applied by a certified NPS employee or state certified contractor.
- Submits to WASO, through the Region a completed Form 10-21A within ten working days.
- Records use of fumigant on park's Pesticide Use Log.

3. The Hazard Communication Standard

In accordance with OSHA's 29 CFR 1910.1200 (Revised 1987) and NPS policy, each park is required to implement a program to communicate essential information on chemical/hazardous materials to employees in the workplace. The Hazard Communication Standard (HCS) is similar to the "Right-to-Know" laws passed by several states. In the curatorial work space this standard requires the following procedures:

- **Inventory all hazardous substances**

- **Obtain and maintain Material Safety Data Sheets**

- **Label all hazardous substances**

- **Receive training in the Hazard Communication Standard**

a. Inventory All Hazardous Substances

Work with your supervisor in conducting an inventory of all products used in museum work that contain hazardous substances. Information on the ingredients of products is obtained from container labels and from Material Safety Data Sheets (MSDS). Figure 11.2 provides a sample form that can be used to record this inventory. This inventory must be performed annually.

Some materials become increasingly hazardous over a long period of time (e.g., resins, ethyl ethers, oxidizers). Determine receiving dates of all materials. If dates are not available, consider disposing and restocking of materials. Unidentified chemicals/substances pose a risk. Consult the park's Safety Coordinator about proper procedures for identifying and disposing of unidentified chemicals/materials.

NATIONAL PARK SERVICE
SAMPLE HAZARDOUS CHEMICAL INVENTORY SHEET

Chemical Name: ____________________

Synonyms: ____________________

Trade Names: ____________________

MSDS Reference: ____________________

Supplier Name: ____________________

Address: ____________________

Phone Number: ____________________

Use Information

Location	Frequency	Quantity	Used By

Storage Information

Location	Quantity

Date: ____________________

Inventory Completed by: ____________________

Review Dates: ____________________

Supervisor's Signature: ____________________

Figure 11.2. Sample Hazardous Chemical Inventory Sheet

b. Obtain and Maintain Material Safety Data Sheets

A Material Safety Data Sheet (MSDS) is concisely written information designed for employers and employees in both the manufacturing and the non-manufacturing sectors to communicate the hazards of the substances used in the workplace and the safety measures required to use and handle them. The OSHA standard does not require that Material Safety Data Sheets be uniform in format; however, each sheet must contain the following information:

1) Product name and identification of chemical(s)

Pertinent information includes identification of the substance; manufacturer's name; gives both the chemical and trade names and any synonyms for these names; tells the chemical family the substance belongs to and its formula; lists the name and address of the manufacturer and an emergency telephone number; lists the hazardous ingredients the substance contains; relates the percentage of each ingredient the substance contains and gives recommended exposure limits for these ingredients.

2) Physical and chemical characteristics of each hazardous chemical

A material's physical properties include boiling point, melting point, appearance and odor threshhold, solubility in water, and evaporation point. Other important information includes a description of any fire or explosion hazards (e.g., flash point, flammable limits; fire extinguishing equipment needed); a list of substances (e.g., water or other chemicals) that cause it to burn, explode, or release toxic gases and a list of environmental conditions (e.g., heat, direct sunlight) that cause a dangerous reaction. This information is especially important in emergencies such as fire.

3) Health hazards

Health hazards include: known acute and chronic health effects, exposure limits, known or suspected carcinogenic effects of chemicals)

Pertinent information includes: the permissible exposure level (PEL), threshold limit value (TLV); the health effects (acute and chronic) that can occur when the recommended level is exceeded and emergency and first-aid procedures. EPA requires that the form also tell the primary route of exposure for the substance (e.g., skin, nose, and mouth).

4) Special protective information (e.g., ventilation and protective equipment)

Pertinent information includes special control measures such as ventilation requirements for the work area and appropriate

personal protective equipment (e.g., respirators, gloves, goggles, clothing for workers).

5) Spill or leak procedures, handling and storage information

Pertinent information includes special handling and storing precautions (e.g., procedures for cleaning up spills and leaks and for disposing of the resulting waste). These procedures are often regulated by the U.S. Department of Transportation and by statutes and laws like the Toxic Substances Control Act and the Resource Conservation and Recovery Act. This information is especially important when the park prepares its Emergency Operations Plan.

An MSDS may be issued in the format illustrated in Figures 11.3a-b, in the form of a computer printout, or in another format that has been developed by the manufacturer.

To ensure that MSDS are received with all orders, parks should request them on purchase orders from the General Services Administration (GSA) and other vendors. Keep them in an easily accessible file in the curatorial workplace.

c. <u>Label All Hazardous Substances</u>

OSHA's Hazard Communication Standard requires that all chemical labels include appropriate hazard warning. The following information, recommended by the American National Standards Institute, should be included on labels:

- Chemical Name and Any Synonym
- Signal Word (indicates the degree of severity of a hazard in the diminishing order: DANGER!, WARNING!, CAUTION!) The word POISON! should be used only for highly toxic chemicals.
- Statement of Hazard
- Precautionary Statement
- Effects of Over Exposure
- First Aid Procedures
- Chemical Abstract Service Number

Curatorial staff can prepare labels for containers of chemicals used in daily work. Refer to Appendix H for sources of vendors who provide a variety of label materials.

Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communication Standard
29 CFR 1910.1200 Standard must be
consulted for specific requirements

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)

IDENTITY *(As Used on Label and List)*	*NOTE: Blank spaces are not permitted. If any item is not applicable or no information is available, the space must be marked to indicate that.*

Section I

Manufacturer's Name	Emergency Telephone Number
Address *(Number, Street, City, State and Zip Code)*	Telephone Number for Information
	Date Prepared
	Signature of Preparer (Optional)

Section II - Hazardous Ingredients / Identity Information

Hazardous Components (Specific Chemical Identity, Common Names)	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (Optional)

Section III - Physical / Chemical Characteristics

Boiling Point		Specific Gravity (H_2O = 1)	
Vapor Pressure (mm Hg.)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	
Solubility in Water			
Appearance and Odor			

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
Extinguishing Media			
Special Fire-Fighting Procedures			
Unusual Fire and Explosion Hazards			

Figure 11.3a. Sample Material Safety Data Sheet (front)

Section V - Reactivity Data			
Stationary	Unstable		Conditions to Avoid
	Stable		
Incompatability *(Materials to Avoid)*			
Hazardous Decomposition or Byproducts			
Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur		

Section VI - Health and Hazard Data			
Route(s) of Entry:	Inhalation?	Skin?	Ingestion?
Health Hazards *(Acute and Chronic)*			
Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?
Signs and Symptoms of Exposure			
Medical Conditions Generally Aggravated by Exposure			
Emergency and First-Aid Procedures			

Section VII - Precautions for Safe Handling and Use
Steps to be Taken in Case Material is Released or Spilled
Waste Disposal Met~od
Precautions to Be Taken in Handling and Storing
Other Precautions

Section VIII - Control Measures		
Respiratory Protection *(Specify Type)*		
Ventilation	Local Exhaust	Special
	Mechanical *(General)*	Other
Protective Gloves		Eye Protection
Other Protective Clothing or Equipment		
Work / Hygienic Practices		

Figure 11.3b. Sample Material Safety Data Sheet (back)

A useful, effective system for labelling has been developed by the National Fire Protection Association. This system rates the health, fire, and reactivity hazard of a substance to warn personnel during a fire. It uses a diamond shaped symbol to designate specific hazards. Figure 11.4 illustrates the NFPA Hazard Symbol. This hazard warning system uses a 0 to 4 rating system with 0 being the least hazardous and 4 the most hazardous. This label can be used on any size containers. Labels also can be posted on access doors to materials storage room or cabinets containing hazardous materials (e.g., cellulose nitrate negatives) as a warning to all employees and to firefighters. Refer to Figure 11.5 for an explanation of the NFPA warning rating system.

Figure 11.4. The NFPA Hazard Symbol. Each colored square corresponds to the indicated type of hazard.

Blue Square: <u>Health Hazard</u>	Red Square: <u>Fire Hazard</u>	Yellow Square: <u>Reactivity Hazard</u>
4-DEADLY: May be fatal on short exposure. Specialized protective equipment required.	4-DANGER: Flammable gas or extremely flammable liquid (Flash point - below 73°F).	4-EXTREME DANGER: Material may detonate at room temperature.
3-EXTREME DANGER: Corrosive or toxic. Avoid skin contact or inhalation.	3-WARNING: Flammable liquid (Flash point - below 100°F).	3-DANGER: May detonate if shocked or heated under confinement, or if mixed with water.
2-HAZARDOUS: May be harmful if inhaled or absorbed.	2-CAUTION: Combustible liquid (Flash point - 100°F to 200°F).	2-WARNING: Unstable, or may react if mixed with water.
1-SLIGHTLY HAZARDOUS: May cause irritation.	1-Combustible if heated (Flash point above 200°F).	1-CAUTION: Unstable if heated, or mixed with water.
0-No unusual hazard	0-Not combustible	0-Stable.

White Square:
<u>Special Hazard Warning</u>

OXY	Oxidizer
ACID	Acid
ALK	Alkali
COR	Corrosive
	Use No Water
	Radiation Hazard

Figure 11.5. The NFPA Hazard Symbol: Key to Color Code and Numbering System.

d. Receive Training About the Hazard Communication Standard

Employees must be trained in the provisions of the Hazard Communication Standard. The Service has a videotape training program with accompaning trainer's guide and student guide. This training program is available from the Regional Safety Manager. In addition employees must receive training in the proper use and handling of materials used in their work. The Material Safety Data Sheet for each material contains information useful for training.

D. HAZARDOUS OBJECTS IN THE COLLECTION

Museum collections may contain a number of types of materials that without proper awareness and precautions pose a health and safety risk to the curatorial staff and to the public, especially researchers. Natural history specimens may be unsafe to handle because they were treated in the past with arsenic or mecuric chloride. Cellulose nitrate and diacetate film emit acidic vapors that may be unhealthful in an improperly ventilated work space. Pharmaceutical and chemical bottles may contain toxic materials. Some substances as they age actually become more toxic. Surgical kits may be contaminated with viable microorganisms or with such substances as strychnine, opium, and morphine. Certain metals (e.g., lead bullets) should be handled with care. Historic firearms may still be loaded. Unexploded ordnance poses a very real danger.

1. Natural History Specimens and Ethnographic Objects

From the 18th century to the mid 20th century both arsenic and mercuric chloride were commonly applied to specimens and ethnographic objects to prevent biological infestation. Arsenic in the form of soap mixtures and sprays were applied to bird and mammal skins and mounts. Arsenic was also used as a fixitive for the preparation of wet specimens to control the growth of microorganisms. Once applied to a specimen, arsenic tends to strongly adhere to hair and feathers. Arsenic retains its toxicity for a long time. Remember: the older the specimen, the greater the chances of the presence of arsenic. Specimens containing arsenic compounds can never be fully decontaminated. Mercuric chloride was used in fixatives for wet specimen collections and as sprays on dry specimens, including herbarium sheets. If it is not possible to determine the presence of these chemicals on a specimen, **ASSUME THAT ARSENIC OR OTHER MATERIAL IS ON THE SPECIMEN/OBJECT.**

a. Arsenic

Arsenic can be readily absorbed through the skin, inhaled and ingested. This substance can cause acute symptoms or may lead over years to chronic disorders. Children and persons with an existing health problem are particularly susceptible to the effects of this substance. In working with bird and mammal specimens collected and prepared prior to the middle 1950's exercise precautions in handling biological specimens.

Follow the following procedures to identify arsenic:

1) Inspect all specimens in the collection. Look for powdery or crystalline deposits on the tips of feathers and hairs, around eyes, in or at the base of ears, around mouth or bill, along ventral incision, at base of tail, and on foot pads. Even if deposits are not evident, all specimens collected and prepared prior to the mid 1950's should be tested. In addition to examining the specimens, where possible, study each specimen's

history. Try to determine who collected and prepared the specimen, when it was collected, and where it was collected.

2) An inexpensive test kit has been developed by EM Science (A Division of EM Industries, Inc.), Gibbstown, New Jersey to detect the presence of arsenic. Use of this kit requires no special training. The kit comes ready to use and requires no mixing, preparation, setup or special equipment. Each kit contains instructions, test strips, reagents and accessories to conduct 100 individual tests. Refer to the NPS Tools of the Trade for sources of this kit.

3) For each test, obtain a sample from the suspect specimen by removing a small amount of the powdery or crystalline residue. Then, follow the instructions provided in NPS Conserve O Gram 2/6, "Arsenic Health Update." If results of first test do not indicate arsenic, collect and test samples from other areas of specimen. The arsenic compound may have not been applied evenly.

4) Tag specimens testing positive for arsenic. Write chemical symbol for arsenic "As" on the specimen's label. Keep good records of each test. File the records in the Museum Records Accession or Catalog Folders.

5) Inform the park safety officer about the project and the results.

Observe and implement the following handling and storage precautions:

6) Do not touch specimens with bare skin. Wear surgical gloves and a protective smock. Wear a dust mask rated for toxic dust. If possible handle specimen by its stand or mount.

7) Always wash hands after working with the specimens. Discard gloves. Keep lab smock or apron clean.

8) Obtain a Material Safety Data Sheet (MSDS) on arsenic and keep in the park's curatorial workspace/office.

9) Museum specimen cabinets housing specimens known to be or suspect of being contaminated with arsenic must be labeled with a warning sign that indicates "ARSENIC". Prepare and post a written set of instructions for handling specimens contaminated with arsenic. Consult the MSDS for specific information on arsenic.

b. Test For the Presence of Mercuric Chloride

The following test is designed to indicate the presence of mercuric chloride. **NOTE: Conduct this test in a well-ventilated space. Conduct steps a. and b. of test in a fume hood.**

Required Chemicals:

- a 50/50 mixture of ethanol and distilled water
- Phenylazoformic acid (2-phenylhydrazide, suitable for colorimetric analysis)

Procedure for Test:

1) Prepare a 0.1% solution of 2-phenylhydrazide in 100 ml of the ethanol and distilled water mixture. (Place a spatula tip quantity of the chemical in a test tube and add approximately 4 ml of the ethanol and water mixture. Heat the test tube in a beaker of hot water and stir until all of the acid has dissolved, then add the acid solution to the remainder of the ethanol and water.) Store the reagent in a clear glass bottle. The reagent should have a pale amber color.

2) Place a powder or crystalline sample from the specimen in a test tube and add a few drops of the phenylazoformic acid solution.

3) A positive test is indicated by the appearance of a pink or magenta color in the fluid.

Note: The test is useful only for powder or crystalline samples. Samples containing silver compounds will also give a positive test.

c. Geological Specimens

There are only a few hazards that may be inherent in geological specimens. Uraninite (e.g., pitchblende) is strongly radioactive. Mineral specimens containing the chemicals antimony, arsenic, barium, boron, copper, fluorine, lead, mercury, uranium, and zinc are toxic. Careless handling of these specimens can lead to ingestion or inhalation of harmful substances. Skin contact with certain minerals may cause an allergic response such as dermatitis. Asbestos minerals are recognized as human carcinogens. Dusts from clay and quartz specimens are potential health hazards. NOTE: Staff working with and handling these geological specimens should wear protective gloves and, where dust is a factor, appropriate masks as well.

2. Cellulose Nitrate and Diacetate Negatives

The volatile, flammable characteristics of aging cellulose nitrate film has long been known. In addition, cellulose nitrate film outgasses by-products that can cause deterioration of other photographic materials stored in the same space.

Deteriorating cellulose nitrate negatives emit nitrogen oxide gases. These gases are considered deep lung irritants. Repeated exposure by inhalation in low concentrations may result in chronic symptoms.

Recently museum staffs working with aging cellulose nitrate and diacetate negatives have developed health problems. Acute symptoms have included eye irritation, rashes and sores on the face and skin, vertigo, nausea, headaches, swollen glands and respiratory irritation and difficulty.

Long-term exposure may result in bronchial irritation and the development of an emphysema-like condition. The silver salts present in negative emulsions may irritate the skin. Diacetate negatives off-gas acetic acid, an irritating and corrosive material.

Acute exposure causes irritation to the upper-respiratory tract. Both types of negatives have a distinct warning property: cellulose nitrate negatives emit a sweet odor; diacetate negatives emit a vinegar odor.

Duplicating and preserving cellulose nitrate negatives is important. Refer to Appendix M for guidance on processing and storing cellulose nitrate negatives. Park staffs need to follow several steps to minimize health risks:

a. Plan for the project. Address required work-space, equipment and time, and identify any special protective equipment that will be needed.

b. Establish proper ventilation in the work space to ensure that concentrations of any emitted gasses are removed from the employee's breathing zone. Refer to Section E of this chapter for a discussion of ventilation and respirators.

c. Goggles may have to be worn, unless proper ventilation is established. Avoid wearing contact lenses when working with negatives for any length of time. Gases may concentrate under contact lenses causing eye injury and damage to the contact lenses.

d. Wear vinyl or latex gloves when handling negatives to minimize risk of skin irritation. Cotton gloves can be worn over latex gloves when handling delicate negatives.

e. Limit the handling and working time to two to three hours per day.

f. After each working session, clean the work surfaces with a solution of baking soda and water. Mix a teaspoon of baking soda to each pint of water. This solution will neutralize the acids deposited by the negatives.

g. Keep a log in the work area to note any odors detected, the time spent each day on the project, and any physical discomforts experienced during and after work. If any ill effects are experienced, notify the supervisor and the Park Safety Officer.

3. Firearms, Ammunition, and Unexploded Munitions

a. Firearms

NPS-44, Property Management Guidelines, Chapter 10, states that all museum firearms must be inspected at the time of acquisition to ensure that they contain no live round(s) of ammunition. Until a historic firearm is examined, consider that it might contain a live round of ammunition. Inspect all breach loading firearms and pistols for cartridges. If any cartridges are discovered, remove them. Exercise great caution in checking a muzzle loader for live ammunition. The steps are as follows:

1) Select a safe, dedicated work area. Place the firearm on a padded table. Point the muzzle in a direction deemed least hazardous, if the piece would accidentally fire. **Never stand in front of a firearm's muzzle.**

2) Obtain a wooden dowel rod that has a diameter smaller than the firearm's caliber and a length longer than its barrel.

3) Ensure that the firearm is not cocked.

4) Wear leather gloves and safety goggles.

5) Standing to the side of the firearm, gently push the dowel into muzzle until it stops. Hold the dowel between the thumb and forefinger so that the dowel will be propelled between the fingers should the firearm discharge. Do not hold the dowel in such a way that it can be propelled into your hand.

6) Place a pencil mark on the dowel where it just clears the muzzle of the barrel.

7) Gently withdraw the dowel from the barrel.

8) Place the dowel on top of the barrel with the pencil mark aligned with the muzzle. If the bottom of the dowel (end not marked) extends the full length of the barrel, the weapon is not loaded. However, if the measurement indicates that the dowel stopped forward of the touch-hole, consider the firearm to be loaded with a live round.

9) Inform the Park Safety Officer of the potential problem. Label the firearm as unsafe and arrange to store it in a safe, secure space.

10) Contact the Regional Curator for instructions on steps to take to have the weapon disarmed.

b. Small Arms Ammunition

Small arms ammunition include Revolutionary and Civil War paper musket cartridges, and metallic cartridges used in the American West as well as contemporary pistol, rifle, and machine gun ammunition from World Wars I and II. Unless damaged in some way, these small arms cartridges do not pose a serious risk. Tests conducted by the U.S. Army, the National Rifle Association, the arms industry, and several fire and insurance companies have repeatedly demonstrated that such ammunition will not detonate by itself. This kind of ammunition requires a direct blow to its primer or a direct spark or flame to detonate the powder. Because the detonation would not be confined within the barrel of a firearm, the pressure would drop rapidly in any accidental detonation. The bullet will fly out with about the same velocity as a cork from a champagne bottle.

Some general rules are as follows:

1) Never attempt to deactivate small arms ammunition. Procedures such as drilling holes in a cartridge case or pulling a bullet to remove the powder and charge can be extremely dangerous. Specialists are available to do this work should it be deemed necessary.

2) As with all museum collections, prohibit smoking.

3) In parks with large collections, store live cartridges in a separate museum specimen cabinet. Clearly label the cabinet with a warning sign to notify fire-fighting personnel.

4) NPS-44 requires that fixed ammunition be rendered inert prior to being placed on exhibit. Contact the Regional Curator for guidance in rendering ammunition inert.

c. Live (Unexploded) Munitions

Unexploded munitions (e.g., cannon balls, Borman fuses, grenades, artillery projectiles) constitute a major health and safety risk. **Any unexploded ordnance discovered in a collection must be treated by staff with extreme caution.** Unless specifically trained and authorized in writing by the Superintendent, park curatorial staff should not handle this material. Park staff discovering ordnance suspected to be unexploded should immediately take the following steps:

1) Do not move or disturb the object.

2) Keep all other persons away from the object. Secure the storage space.

3) Notify the Chief Park Ranger or other designated protection officer and the Park Safety Officer. Contact the Regional Curator.

4) Working with the Chief Park Ranger and the Regional Curator, arrange to have the object(s) examined and evaluated by an appropriate authority to identify the type of ordnance, manufacturer, historic period, and significance.

5) **Considerations for the safety of staff, visitors, and resources take precedence over the preservation of even rare ordnance.** However, if the object is identified to be rare, novel or limited in production (e.g., Whitworth projectile, Armstrong projectile, Confederate Mullane projectile) or is identified in the park's approved Scope of Collection Statement, every attempt should be made to defuse it and preserve the inert object in the collection.

4. <u>Medical Objects and Drugs/Chemicals</u>

Museum collections may contain a variety of objects and substances that pose potential health or safety hazards. Knives, saws, scissors, and other objects from military and civilian medical kits may still carry viable germs and may contain active toxic substances (e.g., strychnine, opium, and morphine). **Handle old medicine or chemical bottles with extreme caution.** The active ingredients of many of these materials, originally very potent, may have become even more potent over time. Drugs, medicinals, and other preparations in pharmaceutical collections may contain toxic materials and/or controlled substances (e.g., narcotics). Such substances are regulated by the Controlled Substances Act of 1970. Bottles containing acids and other corrosive liquids (e.g., sulphuric acid, nitric acid), fuels (e.g., kerosene, naptha•), solvents (e.g., paint thinners, turpentine) may cause personal injury to staff and pose the threat of fire. Very often old chemicals contain such labels as "Oil of Vitriol" (sulfuric acid) and "Aqua Fortis" (nitric acid).

Survey the park's collection to determine if it contains any drugs, medicinals, or other preparations. Report findings to the Park Safety Officer. If the survey identifies that such materials are in the collection, notify the Regional Curator and Regional Safety Manager and proceed with the following steps:

a. Prepare an inventory of the drugs and medicinals. Start with the containers that have labels. Include the following information in the inventory:

- Name of the substance

- All information on the label

- Type of container (e.g., glass bottle, metal canister, cardboard box) and its lid or stopper

- Condition of container (e.g., condition of seal; cracked, chipped bottle; rusty metal; punctured box)

- Other (e.g., strong odor being emitted from container)

List material that cannot be identified. Isolate this material on a separate shelf to facilitate more detailed examination. Assistance with identifying this material can be provided by agents of the U.S. Department of Justice, state agencies, local pharmacists, and local pharmeceutical manufacturers.

b. Conduct detailed examination. Based on the inventory list and, if necessary, an examination by appropriate specialists of the, contents of the containers, the substances can be divided into the following groups:

1) "Over-the-counter" preparations that are considered non-toxic if precautions are followed, and that are not controlled substances.

2) Non-controlled drugs or preparations that may be toxic or potentially hazardous in some applications or that would require a physician's prescription to obtain today.

3) Controlled substances (e.g., narcotics and dangerous drugs) as defined by the Controlled Substances Act of 1970.

4) Drugs that may pose a health/safety hazard because of their age or level of deterioration.

c. Implement an action plan. Based on the findings of the park's inventory and on the detailed examination, pursue the following actions:

1) <u>Retain</u> in the collection those drugs, medicinals, and preparations that are not controlled, that are non-toxic (with usual precautions), and that pose no non-health related hazards to the rest of the collection or to the staff.

2) <u>Retain</u> in the collection drugs and preparations that are not controlled but that may be toxic or that currently require a prescription to obtain but <u>only</u> if they are stable and pose no health related hazards to the rest of the collection or to the staff. Retention of these substances requires that they be properly stored to minimize deterioration and to prevent unauthorized access or use. House this material in a locked utility cabinet.

<u>Note</u>: For items 1) and 2) above, it may not be necessary or prudent to retain large quantities of a substance, particularly if it is a substance that could deteriorate or become unstable in the future to create a safety hazard. If large quantities

are found in the collection, and if destruction of most of a substance is recommended, a small sample should be saved and deposited with the Division of Medical Sciences at the Smithsonian Institution, National Museum of American History. Check with the Division in advance to determine what size sample to save.

3) Destroy drugs and preparations that are controlled substances, that are so toxic that their continued presence in the collection poses an unacceptable risk, or that are an immediate hazard to the rest of the collection or the staff because they are dangerously unstable, corrosive, or explosive. When such material has to be destroyed, for whatever reason, it is vital that a small sample of the substance be retained for research and reference purposes, but only when sampling can be done safely. Such samples will be deposited with the Division of Medical Sciences at the Smithsonian Institution. Samples of controlled substances will be taken, accounted for, and transmitted in accordance with procedures outlined by the Drug Enforcement Administration (DEA). When all or part of a specimen must be destroyed, the DEA will be requested to remove it from the museum and dispose of it properly. If the specimen to be destroyed is not a controlled substance, contact the Regional Hazardous Waste Coordinator for assistance with how to properly dispose of the material.

5. Preservation of Original Containers

a. Substances retained in the collection

When substances are to be retained in the collection, it may be desirable to transfer them to modern containers if there is evidence that the original containers can no longer hold them safely or if health, safety, and security considerations demand that better containers be used. In such instances, preserving the original containers is a high priority. An original unopened container (e.g., with intact seal) can be opened for the purpose of removing its contents only in the following four circumstances: when the act of opening will cause no permanent damage to the container or diminution of its value; when there are urgent and compelling health and safety reasons for opening the container; when the contents are endangering the container (e.g., by corrosion) and removal of the contents is the only way to stop the problem; or when the act of opening the containers poses no safety problem (e.g., container exploding or releasing toxic material). Previously opened containers may be emptied as necessary with routine precautions taken for their preservation. Clean emptied containers of their former contents in an appropriate manner before being returned to storage or display. Consult the Park Safety Officer and the Regional Curator for cleaning methods. A written record must be kept of all actions taken.

b. Substances in the collection are destroyed

When substances in the collection are to be destroyed, preserving the original containers is a high priority. Previously opened containers may be emptied as necessary with routine precautions taken for their preservation. Emptied containers shall be cleansed of their former contents in an appropriate manner before being returned to storage or exhibit. If the container held a controlled substance, <u>no</u> residue of it may remain in the container according to DEA regulations. In no case shall an original unopened container (e.g., with intact seals) be opened solely for the purpose of destroying its contents <u>even if it contains a controlled substance</u> except in the following circumstances: when the act of opening will cause no permanent damage to the container or diminution of its value, or when the contents already have caused deterioration to the extent that the container has become damaged. In such exceptional cases, the act of opening the container shall cause a minimum of additional damage. When collections include original, unopened containers of substances that must be destroyed to comply with the law and when the containers are in good condition and thus would not have to be opened otherwise and when the containers cannot be opened without causing unacceptable permanent damage, the containers and their contents shall be de-accessioned and transferred to the Division of Medical Sciences at the Smithsonian Institution. Full descriptive information about the transferred objects, including one or more photographs, must be kept with the park's catalog records.

E. SAFETY RULES FOR LIFTING AND CARRYING

Chapter 6 discusses the importance of applying proper techniques to lifting and carrying museum objects. Improper handling techniques may lead to accidental damage to an object. In a similar way, improperly lifting and carrying of boxes of objects, furniture and other large and heavy objects may lead to back or limb injuries. Safely lifting and carrying museum objects, as with any material, requires planning before actually lifting or moving material. **Think safety by observing the following procedures:**

1. Planning for Lifting and Moving Materials

    a. Consider the size and weight of the load.

    b. Obtain assistance. If the object is too heavy or bulky, obtain assistance in lifting and carrying it.

    c. Use mechanical help. Use a push cart or handtruck to move heavy or bulky object.

2. Body Mechanics for Lifting and Carrying

    - Keep back arched.
    - Keep head high and chin tucked.
    - Use legs to help with the lift.
    - Get close to the object.
    - Keep feet apart, one foot ahead and one foot behind to maintain a wide base of support.
    - Use golfer's lift technique for light-weight objects.
    - Push or pull large, heavy objects on cart rather than lift when possible.
    - Get help to lift heavy objects.
    - Use teamwork and good communication when two or more are helping with a load.
    - Pivot your feet rather than twisting them when turning with a load.

3. Body Mechanics for Reaching

    - Obtain a step stool for objects slightly out of reach.
    - Maintain mild lumbar curve (proper posture) when reaching overhead.

- Keep heaviest objects stored at levels between knees and chest heights.

NOTE: The above rules are for individual health and safety. They complement the rules for handling objects that are outlined in Chapter 6. Curatorial staff need to employ techniques that keep the safety of the staff and the object in mind.

F. WORKSPACE CONDITIONS

1. Radon

Radon gas is generated during the natural disintegration of uranium. Radon is prevalent in areas where soils and rocks contain uranium, granite, shale, phosphates, and pitchblende or where the soil is contaminated with the by products from uranium or phosphate mining. This colorless, odorless gas seeps into structures through dirt floors, cracks in concrete floors and walls, floor drains, sumps, slab joints, and cracks and pores in hollow-block walls. Radon tends to accumulate in enclosed spaces with levels depending on the structure's construction and on the concentration of radon in the soil.

Radon in the short-lived gaseous state is not harmful. However, the gas breaks down into short-lived radioactive particulates (e.g., heavy metals) called "radon daughters." These radioactive decay products attach themselves to dust or exist as free ions. These radioactive particles inhaled by a person become trapped in the lung tissues and eventually cause lung cancer. Curatorial staff should determine if there is a potential radon problem in museum collection spaces, especially in work and storage spaces (e.g., basements, well-sealed spaces).

a. Procedures for Detecting Radon

1) Discuss a monitoring program with the Park Safety Officer or the Regional Public Health Officer. Levels of radon may already have been identified in park structures.

2) If levels have not been determined, conduct a short-term screening measurement to determine the highest level of radon in the space(s). Two types of radon detectors are the charcoal canister and the alpha tract detector. Both of these devices are exposed to the air in a space for specified period of time and then sent to a laboratory for analysis.

<u>Charcoal Canister</u>: Test Period - 3 to 7 days
Approximate Cost - $10 to $25 for one canister (cost includes lab analysis)

These canisters are available at no cost to the park from the Regional Public Health Office. Consult the Park Safety Manager to obtain a canister.

<u>Alpha Track Detectors</u>: Test Period - 2 to 4 weeks
Approximate Cost - $20 to $50 for one detector

Follow instructions received with either device. The space being monitored should be closed for at least 12 hours prior to starting the test. Keep this space closed as much as practical during the test period.

Results from the devices that measure radon decay products (e.g., charcoal canister, alpha track detector) are reported as "Working Levels" (WL) and from devices that measure concentrations of radon gas are reported as "picocuries per liter" (pCi/l).

3) **The canisters serve as a screening measurement for radon.** There are more precise sampling methods that can be used to quantify the exposures. The EPA has established 0.02 WL or 4 pCi/l to be the action level of radon for residential structures. For occupational exposures, NIOSH recommends 1 WLM/year. The table in Figure 11.6 provides guidance on the actions recommended for the different screening measurements.

Screen Measurement	Action
• Less than 0.02 WL or 4pCi/l	Follow-up measurements not required. Reduction in these levels not required.
• 0.02 WL to 0.1 WL or 4 pCi/l to 20 pCi/l	Perform follow-up measurements. Expose detectors for 1 year. Take action(s) to reduce levels within one year.
• 0.1 WL to 1.0 WL or 20 pCi/l to 200 pCi/l	Perform follow-up measurements. Expose detectors for no more than 3 months. Take action(s) to reduce levels within months.
• Higher than 1.0 WL or 200 pCi/l	Immediately perform follow-up measurements. Expose detectors for no more than one week. Take actions to reduce levels immediately. Until levels are reduced, do not work in space.

Figure 11.6. Recommended Actions for Levels of Radon[1]

b. Methods for Mitigating a Radon Problem

1) Reduce the flow of radon into the space. The methods for reducing radon flow include covering exposed earth and sealing cracks and openings (e.g., pores in concrete blocks; openings around utility pipes, joints between basement floors and walls, floor drains). This method can achieve at a small cost the desired reduction in radon levels. It must be implemented before other methods are used.

2) Ventilation (e.g., natural, forced, and heat recovery). Ventilation reduces radon levels by replacing radon-laden indoor air with outdoor air. These methods may not be conducive to maintaining the appropriate environment for museum objects.

3) Installation of a system to keep radon from entering space. These more expensive methods include drain-tile suction, sub-slab suction, and block-wall ventilation prevention of space de-pressurization, and space pressurization.

NOTE: At the present time, the Environmental Protection Agency (EPA) does not endorse the use of air cleaners as a method of reducing radon levels because this technology has not been demonstrated to be effective in reducing the health risks associated with radon.

For a detailed discussion on radon reduction methods, obtain a copy of the EPA publication Radon Reduction Methods--A Homeowners Guide (Second Edition) from the nearest EPA Regional Office. This booklet is listed in Section H of this chapter.

2. The Workspace

A safe and healthful curatorial work environment includes good lighting, ventilation, good housekeeping, appropriate type and number of fire extinguishers, and a comfortable chair. All of these factors relate to ergonomics. Consult with the Park Safety Officer on steps that can be taken to improve the workspace.

G. GLOSSARY[2]

Acute	Severe, often dangerous conditions in which relatively rapid changes occur.
Acute Exposure	An intense exposure to a hazardous substance over a relatively short period of time.
Boiling Point	The temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which the liquid changes to a vapor. The boiling point is usually expressed in degrees Fahrenheit. <u>If a flammable material has a low boiling point, it indicates a special fire hazard</u>.
Breathing Zone	The ambient environment in which a person performs normal respiration (around nose and mouth).
Ceiling ("C")	The concentration of a substance that should not be exceeded, even for an instant. It may be written as Threshold Limit Value-Ceiling or TLV-C.
Carcinogen	A substance or physical agent that may cause cancer in animals or humans.
Chronic	Persistent, prolonged or repeated conditions.
Chronic Exposure	A prolonged exposure occurring over a period of days, weeks, or years.
Combustible	Combustible liquids are those having a flash point at or above 100°F (37.8°C), or liquids that will burn. They do not ignite as easily as flammable liquids. However, combustible liquids can be ignited under certain circumstances, and must be handled with caution. Substances, such as wood and paper are termed "ordinary combustibles."
Flammable Liquid	A flammable liquid is one that has a flash point below 100°F.
Flash Point	The lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture and burn when a source of ignition (e.g., sparks, open flames, cigarettes) is present. Two tests are used to determine the flash point: open cup and closed cup. The test method is indicated on the MSDS after the flash point.
Hazardous Material	A chemical or mixture of chemicals that is toxic, highly toxic, an irritant, a corrosive, a strong oxidizer, a strong sensitizer, combustible, flammable, extremely flammable, dangerously reactive, pressure-generating, or

otherwise may cause substantial personal injury or substantial illness during or as a direct result of any customary or reasonable foreseeable handling or use.

Lower Explosive Limit (LEL)	The lowest concentration of a substance that will produce a fire or flash when an ignition source (e.g., flame, spark) is present. It is expressed in percent of vapor or gas in the air by volume. Below the LEL the air/contaminant mixture is theoretically too "lean" to burn.
Mutagen	Anything that can cause a change (or mutation) in the genetic material of a living cell.
Narcosis	Stupor or unconsciousness caused by exposure to a chemical substance.
Odor Threshold	The minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor.
Permissible Exposure Limit (PEL)	An exposure limit that is published and enforced by OSHA as a legal standard. PEL may be either a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling (C). The PELs are found in Tables Z-1, Z-2, or Z-3 of OSHA regulations 1910.1000.
Reactivity	A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosion, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, mixing with water and dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on a MSDS.
Short Term	The maximum concentration to which workers can be Exposure Limit exposed for a short period of time (15 minutes) for (STEL) only four times throughout the day with at least one hour between exposures.
Threshold Limit Value	Airborne concentrations of substances established by the ACGIH that represents conditions under which it is (TLV) believed that nearly all workers may be exposed day after day with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLVs: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C).

Time Weighted Average (TLV-TWA)	The average time, over a given work period (e.g., 8-hour workday), of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period.
Toxicity	The potential of a substance to exert a harmful effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place.
Trade Name	The commercial name or trademark by which a chemical is known. One chemical may have a variety of trade names depending on the manufacturers or distributors involved.
Upper Explosive Limit (UEL)	The highest concentration (expressed in percent of vapor or gas in the air by volume) of a substance that will burn or explode when an ignition source is present. Theoretically, above this limit, the mixture is said to be too "rich" to support combustion. The difference between the LEL and the UEL constitutes the flammable range or explosive range of a substance. That is, if the LEL is 1 ppm and the UEL is 5 ppm, then the explosive range of the chemical is 1ppm to 5 ppm.
Vapor	The gaseous form of substances that are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids, such as solvents. Solvents with low boiling points will evaporate readily.

H. SELECTED BIBLIOGRAPHY

Center for Occupational Hazards: Data Sheets
1983 "Safe Pest Control Procedures for Museum Collections"
1985 "A Health and Safety Program for Conservation Laboratories"
1985 "Emergency Plans for Museum Conservation Laboratories"
1985 "Ventilation for Conservation Laboratories"
1985 "Fire Prevention in the Conservation Laboratory"
1985 "Solvents in Museum Conservation Labs"
1985 "Chemical Storage and Disposal in the Conservation Lab"

Clark, Nancy, Cutter, Thomas and McCrane, Jean-Ann
1984 Ventilation A Practical Guide. NY, NY: New York Center for Occupational Hazards.

Cumberland, Donald C.
1989 "Installing the Retrofit Gasket Kit," NPS Conserve O Gram 4/8, Washington, D. C.: National Park Service, Curatorial Services Division.

Day, Nancy Raines
1984 Back to Backs, A Guide to Preventing Back Injury. Daly City, CA: Kranes Communications.

Hawks, Catherine A. and Williams, Stephen L.
1986 "Arsenic in Natural History Collections," Leather Conservation News, 2:2:1-4. Austin, TX: Texas Memorial Museum.

Howie, F., editor
1987 Safety in Museums and Galleries. London/Boston: Butterworth and Co. (Publishers) Limited.

Knapp, Anthony M.
1987 "Ethylene Oxide Health and Safety Update," NPS Conserve O Gram 3/15. Washington, D.C.: National Park Service, Curatorial Services Division.

______.
1988 "Hazardous Materials Health and Safety Update," NPS Conserve O Gram 2/5. Washington, D.C.: National Park Service, Curatorial Services Division.

MacLeish, A. Bruce
1985 The Care of Antiques and Historical Collections, Chapter 3, pp. 39-40; Chapter 6, pp. 69-74. Nashville, Tennessee: American Association for State and Local History.

McCann, Michael
1979 Artist Beware. New York: Watson-Guptill Publications.

McGiffin, Robert F., Jr.
1983 Furniture Care and Conservation, Chapter 11, "Health Hazards and Safety Practices," pp. 156-165. Nashville, Tennessee: American Association for State and Local History.

McGiffin, Robert F., Jr.
1985 "Health and Safety in the Museum Workplace," Museum News, 64:2:36-43. Washington, D.C.: American Association of Museums.

National Safety Council
1985 The Facts About the Hazard Communication Standard, A Guidebook. Chicago, Illinois: National Safety Council.

Olishifski, Julian B., Editor-in-Chief
1979 Fundamentals of Industrial Hygiene (Second Edition). Chicago, IL: The National Safety Council.

Raphael, Toby
1985 "Paradichlorobenzene Health and Safety Update," NPS Conserve O Gram 3/14. Washington, D.C.: National Park Service, Curatorial Services Division.

Rossol, Monona.
1987 Revised OSHA Standard Affects Museums, Conservation Labs and Schools, (Information Sheet). New York: Arts, Crafts and Theater Safety (ACTS).

Roueche, Berton
1986 "Annals of Medicine-Cinnabar," The New Yorker (December 8, 1986), pp. 94-102.

Sax, N. Irving and Lewis, Richard J. Sr., editors.
1986 Rapid Guide to Hazardous Chemicals in the Workplace. New York: Van nostrand Reinhold.

Sease, Catherine
1987 A Conservation Manual for the Field Archeologist, Archeology Research Tools, Vol. 4, Chapter 2: "Safety," pp. 5-21. University of California at Los Angeles: Institute of Archeology.

U.S. Environmental Protection Agency (EPA)
1987 Citizen's Guide to Pesticides. Washington, DC: Environmental Protection Agency, Office of Pesticides and Toxic Substances.

1986 Understanding the Small Quantity Generator Hazardous Waste Rules: A Handbook for Small Business. Washington, DC: Environmental Protection Agency, Office of Solid Waste and Emergency Response.

1986 A Citizen's Guide to Radon: What It Is and What To Do About It. Washington, DC: Environmental Protection Agency, Office of Air and Radiation.

1987 Radon Reduction Methods, A Homeowner's Guide (Second Edition). Washington, DC: Environmental Protection Agency, Office of Air and Radiation.

I. ENDNOTES

1. The table in Figure 11.6 is based on data in the Environmental Protection Agency's pamphlet A Citizen's Guide to Radon: What It Is and What to Do About It (1986).

2. This glossary was prepared by excerpting selected terms and definitions from the Glossary (Appendix D), 1161-1234, in the book Fundamentals of Industrial Hygiene (Second Edition) edited by Julian B. Olishifski.

CHAPTER 12. CURATORIAL PROGRAMMING, FUNDING, AND STAFFING

A. PROGRAMMING FOR MUSEUM COLLECTIONS MANAGEMENT

1. Planning

As discussed in Chapter 1, Section E, the first step in programming for museum collections management is planning. Begin by becoming familiar with the park's museum collection to determine present size and scope, status of accountability and documentation, security and environment of storage and exhibit spaces, relevancy, and use. Analyze the status of the collection against NPS curatorial standards and requirements to identify deficiencies. Prepare a list of needs that are required to correct all deficiencies. Divide the list of these needs into two categories:

- Needs that can be met by existing park funds and staff (e.g., revise Scope of Collection Statement, purchase a hygro-thermograph, obtain sticky traps for monitoring pest activity, catalog newly accessioned objects)

- Needs that require additional funds and staff (e.g., new collections storage area, intrusion detection system, object conservation treatment, Collection Management Plan).

Prioritize both lists of needs. Begin working on those projects that can be accomplished with existing resources.

Begin working on list of needs that require additional resources to accomplish. Develop alternative methods for accomplishing a project and establish estimated costs. Consider phasing large projects over several years. Integrate these major needs into appropriate park planning documents. Ensure that collections management project statements are included in the park's Resources Management Plan (RMP). Examples of project statements are as follows:

- Catalog Museum Objects
- Store Museum Collections
- Prepare Collection Management Plan
- Install Intrusion Alarm System
- Conduct Collection Condition Survey
- Perform Conservation Treatment

Contact the Regional Curator for assistance. This planning process leads to the generation of programming and budgeting documents (e.g., Development/Study Package Proposal Form 10-238). These documents are necessary to accomplish collection management projects that require resources beyond the park's existing funding base. Review and update project statements in the Resources Management Plan as existing projects are completed or as new ones are identified.

2. Preparing the Programming Document

The programming document is the result of good planning. It is the key to obtaining funds for a project. It should provide the

manager with a succinct, clear definition of the project needs. Answer the following questions:

- What is the project?
- Why is the project required?
- How much will the project cost?
- How will the money be spent?

Remember: the persons who will review these documents will not be familiar with the problem(s). A well-written document has a better chance of being approved. In preparing programming documents, keep in mind the time needed to actually receive the funds. If a programming document prepared in Fiscal Year 1988 receives approval, the funding will be allocated in Fiscal Year 1990. A few general guidelines for completing a programming form are as follows:

a. Know Which Form to Use

The Development/Study Package Proposal, Form 10-238 is used to request special, one-time and/or emergency funds. Form 10-237 is often used to request recurring, annual needs (annual increase) and cyclic maintenance funds. Contact the Regional Curator for the appropriate form to use. Some regions use different forms for cyclic maintenance (e.g., the Job Order Request, Form 10-577).

b. Know How to Fill Out the Form

The format for completion of forms varies slightly from region to region. Consult the Supervisor, Park Administrative Officer, and

Regional Curator. Ask these people to review and edit your efforts and return them for revision.

c. Use Project Titles with Strong Action Verbs

The project title is the first opportunity to "sell" the project. Make the title brief, yet state concisely what needs to be done. Use action verbs whenever possible. The project "REPAIR PAINTINGS" would have more force as "PROVIDE EMERGENCY CONSERVATION FOR PAINTINGS." "NEED CLERK TYPIST" might be better stated as "PROVIDE CLERICAL SUPPORT FOR MUSEUM RECORDS."

d. Concisely Describe the Project

The section titled "FULL PACKAGE DESCRIPTION" on the Form 10-238, and "FULL DESCRIPTION AND JUSTIFICATION" on the Form 10-237, is the place to provide a brief, concise statement of the problem and what action is planned. Use short sentences with action verbs to get the reader's attention.

e. Concisely State Why the Job Needs to be Done

On Form 10-238 information on why the action is needed goes under the section titled "PACKAGE JUSTIFICATION/CONSEQUENCES." On Form 10-237 this information is a continuation of the section mentioned above. Use concise sentences, outlining what will happen if the work is not performed. Cite NPS curatorial policies, standards and requirements. If appropriate cite laws, regulations, Executive Orders to show that the project is a legal responsibility of the Service. Indicate what will happen if the project is not funded. If possible, show how the Service will save money by doing the project now instead of deferring it. Whenever possible, attempt to provide a realistic, defensible figure of what you think the project will cost. If you have formal estimates, include them; otherwise, use the word "projected."

f. Form Appearance

Review accuracy of grammar, spelling, sentence structure and math. Submit a clean copy for review.

g. Always Sign and Date the Form

As the originator, you have done the basic research. Someone along the review process may want more information and need to know whom to contact. Accordingly keep a readily accessible file with all notes on the project.

h. Monitor Progress of the Document

Keep a copy of each programming document with the package number assigned by the park. Sometimes forms are lost and sometimes people along the line will want to check wording or figures. Keep in touch with your supervisor and the Regional Curator about the progress of the project document(s). Refer to Section D of this chapter for examples of completed programming documents.

3. <u>Budgeting for Ongoing Curatorial Program</u>

Data on the work elements of a park's curatorial program is essential for developing a budget. Document the <u>ongoing</u> curatorial workload and costs that are required to properly manage and care for the park's museum collection. Steps in this process include:

a. Identify all the museum collections management work activities.

b. Describe each work activity.

c. Outline the procedures required to complete each activity.

d. Maintain a daily record of the hours spent on each work activity.

e. Keep a record of the costs of curatorial supplies and materials used in each work activity.

At the end of each year, the data will help to identify what activities cannot be performed within the park's base funding for curatorial staff and supplies.

The NPS Maintenance Management (MM) program provides a formalized process and procedures for managing maintenance operations in all parks. This program documents not only the work that has been funded, but the work that has not been funded (e.g., the shortfall). Park curatorial staff should discuss with park maintenance staff how museum collection maintenance work activities could be incorporated in this program.

SOURCES OF CURATORIAL FUNDING

Funding for the park's museum collection management program can come from several sources. These sources include:

- Park Operations (PWE 300)
- Cultural Resources Preservation Fund (PWE 302)
- Cultural Resources Cyclic Maintenance (PWE 301)
- Conservation Treatment Services at Harpers Ferry Center
- Exhibit Repair/Rehabilitation Program
- Other Funding Sources

1. Park Operations (ONPS)

   The park's curatorial program should have an adequate funding base. The size and nature of a park's museum collection helps to establish required base funding. The amount of base funding should be enough to keep the curatorial program operating at an acceptable level without having to rely heavily on special project funds. ONPS funds should be directed at maintaining an ongoing program of accounting and documenting new acquisitions and of preventive conservation for objects in storage and on exhibit. This funding covers the collections management program on an annual basis: the cost of curatorial staff, clerical support; curatorial supplies, materials, and references; and travel to training courses and professional meetings. The Request for Base Increase, Form 10-237 is used to request the need for additional park operation funds.

2. Cultural Resources Preservation Fund (CRPF)

   This fund is managed by the Washington Office. This source of funds may be used to correct major deficiencies in the park's collections management program (e.g., obtain a Collection Management Plan, rehabilitate a museum collections storage space, install an intrusion alarm system, catalog the backlog of museum objects). All projects to be funded by this money must be identified in the park's Resources Management Plan. Based on the Resources Management Plan, a park submits priority lists of projects and the corresponding Development/Study Package Proposal Form 10-238 to the Regional Office. Funding for projects may be programmed over multi-years. The Regional Office reviews the requests, assigns regional priorities to the projects, and forwards the package to the Washington Office. At this level regional priorities are reviewed and funding is distributed.

3. Cultural Resources Cyclic Maintenance

   This fund is managed by the Regional Office. Each park receives an annual call from the region requesting programming documents for these funds. This source of funds may be used for the treatment of museum collections (cultural and natural history) on a greater-than-one-year cycle. The park must skip at least one year in the funding cycle. Projects carried out on a regular schedule (e.g., object conservation treatment--one year-metal treatment; next

object conservation treatment--one year-metal treatment; next year-paper treatment), are funded by this money. The programming document used varies from region to region (e.g., Form 10-238 and Form 10-577 are used). Consult the Regional Curator about the appropriate form.

4. Object Conservation Treatment Services at Harpers Ferry Center (HFC)

   In lieu of programming funds to obtain object conservation treatment, parks may request such services from the Division of Conservation, HFC. Parks should complete an Object Treatment Request Form 10-252 (OTR) (Revised 7/86) through the Regional Curator to HFC. These requests can be submitted anytime throughout the year. Refer to Chapter 8, Section D for instructions on completing the OTR Form.

5. Exhibit Repair/Rehabilitation Program

   This fund is managed by the Harpers Ferry Center, HFC. It is available for the repair, maintenance, and redesign of museum exhibits, waysides, and audio visual installations, and the preservation and protection of museum objects on exhibit. Requests for these funds are made by memorandum through the Regional Office to HFC. When museum objects are involved, the Regional Curator reviews the exhibit plan.

6. Other Funding Sources

   Emergency treatment to stabilize objects damaged by a disastrous event may be necessary. Consult the Regional Curator about the procedures for obtaining funding for this work. This information should be incorporated in the park's Emergency Operation Plan.

   Some parks have developed a "Gift Book" as fund raising strategy for particular needs. The curatorial program can benefit from this strategy. List such items as hygrothermographs, portable humidifiers and dehumidifiers, museum specimen cabinets, and acquisition of needed objects. The park's cooperating association and other organizations directly associated with the park and its museum collection may apply for funding for special projects from government funding agencies, such as the National Endowment for the Arts (NEA), the National Endowment for the Humanities (NEH) and other foundations and individuals. Refer to Appendix C for a list of the names and addresses of these organizations and foundations.

C. STAFFING FOR MUSEUM COLLECTIONS MANAGEMENT

Every park with a museum collection should designate one person with the responsibility for museum collection management. **The person's duties, whether a museum curator, specialist or technician or a person in another classification with collateral curatorial duties, should be described in position descriptions and critical elements of performance standards.** Consult the Regional Curator for assistance in developing position descriptions for curatorial staffing requests. The Regional Curator should be involved in developing performance standards and evaluating the performance of a person with collateral curatorial duties.

1. Classification Standards

The Office of Personnel Management (OPM) Classification Standards identify two occupation series for those charged with the performance of professional and technical duties related to the operation of federal museums. The Museum Curator Series (GS-1015) is the professional series for positions, the primary duties of which are to administer, supervise and perform professional work related to research, collections management, exhibits and education in museums. Positions in the Museum Specialist and Technician Series (GS-1016) have duties that include technical and specialized work in connection with the management of museum collections. Most career employees in both series choose a subject matter specialization that can range from one of the traditional museum functions such as collection management or exhibits, to a subject matter, such as art, history, anthropology, biology, or conservation.

The OPM classification standards for the museum curator series indicates the minimum acceptable grade for a person working independently in a small, medium, and large sized collection. The position description for the Park Curator should reflect the following elements, which are considered in classifying curator positions:

- size and complexity of the collection
- involvement with long-range planning for expansion, improvement, use, and security of the collection
- responsibility for developing operating policy
- monetary, scientific, and historic significance of the collection
- requirements for knowledge, initiative, imagination, and independent professional judgement
- nature and extent of supervisory controls
- degree of supervisory responsibility
- scope of research projects
- frequency of use of the collection by scholars and the resultant exchange of objects, ideas, and information
- complexity of identification and authentication of museum objects and degree to which such work is dependent upon available precedents

- degree of involvement in exhibit planning and design
- extent of public service and educational assignments

Parks with medium to large sized collections can justify additional curatorial positions.

2. Professional Development

The incumbents in curatorial positions must attend the Curatorial Methods Course and other appropriate NPS training or workshops or non-NPS training given by local museums, schools, American Association of Museums and the American Association for State and Local History. The park should maintain membership in appropriate state, regional and national museum associations and societies (see Appendix C of this handbook) and, when possible, send a representative to the annual meetings of these professional organizations. There should be the opportunity to improve museum knowledge and skills and to associate with other professionals in the museum field.

3. Other Sources for Staffing

Other sources of staffing include volunteers from the community and student interns. Volunteers can provide assistance with cataloging, photographing, arranging and organizing the museum storage space and with performing curatorial housekeeping. Park staff need to provide volunteers with sufficient training and close supervision. Parks can also contract for staffing to accomplish projects such as cataloging objects. Refer to the NPS Museum Handbook, Part II, Appendix B for estimating costs for cataloging museum objects.

D. EXAMPLE CURATORIAL PROGRAMMING DOCUMENTS

This section contains examples of programming documents with suggested language for several different types of curatorial projects. The Regional Curator can provide assistance as well as other examples.

FORM 10-238 (REV 1 76)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

PAGE ___ OF ___ FOR THIS PACKAGE

DEVELOPMENT/STUDY PACKAGE PROPOSAL

PACKAGE NO.:
REVISION NO.

ORG NO	PARK (OR OTHER ORIGINATOR)	DEVELOPED AREA (NAME)	D A CODE	REGION

STATE	STATE CODE	COUNTY(S)	CONGRESSIONAL DISTRICT(S)

PACKAGE TITLE: STORAGE ENVIRONMENT

STUDY PACKAGE ☐
NEW CONSTRUCTION B ☐
REHABILITATION A ☐

NEW PACKAGE ☐
REVISION ☐

CRITERIA (INSERT X's)

PROGRAM THRUST, STATUS AND OTHER INFORMATION

ESTIMATED COST $

PARK PRIORITY	DATE	REG'N PRIORITY	DATE

WILL ADDITIONAL OPERATING FUNDS AND POSITIONS BE NEEDED UPON COMPLETION OF THIS PACKAGE?
(IF YES EXPLAIN NEEDS IN SECTION XI OUTLINE OF PLANNING AND MANAGEMENT REQUIREMENTS)

YES ☐
NO ☐

FULL PACKAGE DESCRIPTION

This package provides consolidated, pest-free, environmentally controlled storage for the irreplaceable museum objects at (Park's Name), estimated at 75,000. The collection is a fundamental park resource, forming the park's baseline inventory of natural features, the only link to our prehistory, and part of the park's Historic District. This package will allow park to purchase equipment, organize the specimens and provide environmental control and monitoring equipment.

Currently these objects are scattered among nineteen locations, some of which are subject to fire, theft, pest and water damage. Without proper storage equipment the objects suffer continual physical damage due to overcrowding. Uncontrolled fluctuations of relative humidity and temperature in some locations accelerate object deterioration.

This request will implement Collection Storage Plan approved (date).

PACKAGE JUSTIFICATION/CONSEQUENCES

NPS-28, Cultural Resources Management Guideline, NPS Museum Handbook, and the revised Special Directive 80-1 require the proper storage of museum objects, which this package provides.

Without this package, the curatorial staff will attempt to continually upgrade storage facilities, but will be unable to reach the standards outlined in the NPS Guidelines for proper environmental controls. Further curatorial work, such as cleaning, treatment, inventory, study will be hampered by the continued storage of the collection among the many locations.

PLANNING AND MANAGEMENT REQUIREMENTS *(Follow instructions and outline provided in Program Formulation Guideline)*

SIGNIFICANT ISSUES AND INFLUENCES

1. Time Constraints: The objects at (Park) are suffering rapid deterioration from uncontrolled fluctuations in relative humidity and temperature.

2-3. Not applicable.

4. Public Interest: The objects in storage may be used in exhibits viewed by park visitors and should be cared for with a view to their longevity.

ORGINATOR (Signature and Title)	DATE	CONCURRENCE (Signature of Superintendent or Equivalent Official)	DATE

APPROVAL (Signature of Regional Director or Equivalent Official)	DATE

FORM 10-238
(REV 1 78)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

DEVELOPMENT/STUDY PACKAGE PROPOSAL

PAGE ___ OF ___ FOR THIS PACKAGE

PACKAGE NO.:
REVISION NO.

ORG NO	PARK (OR OTHER ORIGINATOR)	DEVELOPED AREA (NAME)	D A CODE	REGION

STATE	STATE CODE	COUNTY(S)	CONGRESSIONAL DISTRICT(S)

PACKAGE TITLE: REPLACE DEFECTIVE PROTE-CTIVE SYSTEMS HIST BLDGS

STUDY PACKAGE ☐
NEW CONSTRUCTION B ☐
REHABILITATION A ☐

NEW PACKAGE ☐
REVISION ☐

CRITERIA (INSERT X's)

PROGRAM THRUST, STATUS AND OTHER INFORMATION

ESTIMATED $

PARK PRIORITY	DATE	REG N PRIORITY	DATE

WILL ADDITIONAL OPERATING FUNDS AND POSITIONS BE NEEDED UPON COMPLETION OF THIS PACKAGE?
(IF YES EXPLAIN NEEDS IN SECTION XI OUTLINE OF PLANNING AND MANAGEMENT REQUIREMENTS)

YES ☐
NO ☐

FULL PACKAGE DESCRIPTION

Remove existing equipment and install new flexible, state-of-the-art, fire suppression systems in four (4) First and Third Order of significance historic structures. The project will involve the replacement and/or upgrading of existing motion detection/photo eye intrusion and one water type suppression systems, based on study recommendations, in all 4 structures and tying in the recently installed intrusion system in the (Name of Structure), a structure used for museum collections storage, and the systems protecting the park maintenance building. The new system must be designed to allow for future expansion as systems are added and must free, for other uses, telephone line pairs currently tied up by the alarms.

PACKAGE JUSTIFICATION/CONSEQUENCES

See Attached Page

PLANNING AND MANAGEMENT REQUIREMENTS *(Follow instructions and outline provided in Program Formulation Guideline)*

Study and evaluation of existing systems must be conducted to determine needs in light of existing technology.

ORGINATOR (Signature and Title)	DATE	CONCURRENCE (Signature of Superintendent or Equivalent Official)	DATE

APPROVAL (Signature of Regional Director or Equivalent Official)	DATE

Form 10-238, "Replace Defective Protective Systems Hist. Bldgs."

Package Justification/Consequences

The (Name of Structure) is the site's primary historic resource. It, along with the reconstructed Blacksmith Shop, Meetinghouse and Schoolhouse from the period, form the historic core area. All four structures, and the (Name of Structure), contain many rare, unique and valuable museum objects. The loss of the structures and their contents to fire, theft or water damage would mean the loss of nationally significant historic materials. Wholly inadequate, the present intrusion alarm system is a collection of systems, added piece-meal and is unreliable, deteriorating, and in constant need of repair. The entire system has been down several times in the past 12 months for up to 3 days at a time. The system is tying up so many pairs of telephone lines into the Federal Office building that the park is unable to provide adequate telephone service to meet staff needs and there are no pairs available to bring the (name) intrusion alarm systems, when completed, into the main system. The fire detection/ suppression system was installed 20 years ago to protect the (name) and the Blacksmith Shop and is presently in need of repair. It must be replaced with a system designed to protect both the structures and contents, with a minimum of damage to the contents when activated and with little visual intrusion. At present, all alarm systems are being monitored in non-business hours by the (name of agency). There is a good possibility that the guard service at the (name of agency) may be contracted. If that were to happen, with staffing limitations, it will be necessary for the park to rely even more on the intrusion/fire protection systems and have a central location to monitor them.

FORM 10-238
(REV 1 78)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

PAGE ___ OF ___
FOR THIS PACKAGE

DEVELOPMENT/STUDY PACKAGE PROPOSAL

PACKAGE NO.:
REVISION NO.

ORG NO	PARK (OR OTHER ORIGINATOR)	DEVELOPED AREA (NAME)	D A CODE	REGION

STATE	STATE CODE	COUNTY(S)	CONGRESSIONAL DISTRICT(S)

PACKAGE TITLE: CONSERVATION TREATMENT OF MUSEUM OBJECTS

STUDY PACKAGE
NEW CONSTRUCTION B
REHABILITATION A

NEW PACKAGE
REVISION

CRITERIA (INSERT X s)

PARK PRIORITY	DATE	REG N PRIORITY	DATE

PROGRAM THRUST, STATUS AND OTHER INFORMATION

ESTIMATED COST $

WILL ADDITIONAL OPERATING FUNDS AND POSITIONS BE NEEDED UPON COMPLETION OF THIS PACKAGE?
(IF YES EXPLAIN NEEDS IN SECTION XI OUTLINE OF PLANNING AND MANAGEMENT REQUIREMENTS)
YES
NO

FULL PACKAGE DESCRIPTION

Phase I of this project will produce a Collection Condition Survey. This survey will report the physical condition of the park's collection, detail general improvements and individual object treatment required to develop a schedule for treatment.

Phase II will provide treatment for those objects most urgently needing it, with full treatment report and recommendations for future storage and/or exhibit maintenance. At this point normal cyclic maintenance may be expected to take over regular scheduled treatment.

Storage equipment will be purchased as part of the project, equipment and materials necessary for on-site treatment, contract or in-house treatment costs, and entering information into the Automated National Catalog System for those objects treated and stored.

PACKAGE JUSTIFICATION/CONSEQUENCES

A. (Park name) is a National Historic Landmark (NHL) property. The collections are included in that designation.

B. Benefits will be the care and preservation of this (NHL) property.

C. Problem to be solved is the deterioration and storage conditions of objects in this cultural resource.

D. The effects of not funding will be the continued deterioration and ultimate loss of objects in the museum collections.

PLANNING AND MANAGEMENT REQUIREMENTS *(Follow instructions and outline provided in Program Formulation Guideline)*

BACKGROUND AND STATUS:
The park collections are objects from and associated with a NHL property. These objects are in various states of preservation/deterioration. They pose a series of problems in providing adequate maintenance and preservation. This survey and treatment schedule will allow the park to respond to the unique requirements of the collection preventing the loss of historically significant materials.

ORIGINATOR (Signature and Title)	DATE	CONCURRENCE (Signature of Superintendent or Equivalent Official)	DATE

APPROVAL (Signature of Regional Director or Equivalent Official)	DATE

FORM 10-238
(REV 1 76)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

PAGE ____ OF ____
FOR THIS PACKAGE

DEVELOPMENT/STUDY PACKAGE PROPOSAL

PACKAGE NO.:
REVISION NO.

ORG NO	PARK (OR OTHER ORIGINATOR)	DEVELOPED AREA (NAME)	D A CODE	REGION

STATE	STATE CODE	COUNTY(S)	CONGRESSIONAL DISTRICT(S)

PACKAGE TITLE: PRODUCE COLLECTION MANAGEMENT PLAN

STUDY PACKAGE ☐
NEW CONSTRUCTION B ☐
REHABILITATION A ☐

NEW PACKAGE ☐
REVISION ☐

CRITERIA (INSERT X's)

PROGRAM THRUST, STATUS AND OTHER INFORMATION

ESTIMATED COST $

PARK PRIORITY	DATE	REG N PRIORITY	DATE

WILL ADDITIONAL OPERATING FUNDS AND POSITIONS BE NEEDED UPON COMPLETION OF THIS PACKAGE? YES ☐ NO ☐
(IF YES EXPLAIN NEEDS IN SECTION XI OUTLINE OF PLANNING AND MANAGEMENT REQUIREMENTS)

FULL PACKAGE DESCRIPTION

Currently the park collection contains an estimated ______objects. The Collection Management Plan will evaluate all phases of the park's museum collection management program. Topics will include an evaluation of the Scope of Collection Statement, status of the Accession Book and File, status of the existing catalog records, evaluation of the present storage area and facilities, evaluation of storage and exhibit environment, recommendations for curatorial maintenance, recommendations for conservation, recommendations for security and an analysis of staffing and funding needs both current and projected. The Collection Management Plan is a site specific document and is viewed as a working tool meant to guide the on-site staff in the day-to-day development, management and preservation of the park collection.

PACKAGE JUSTIFICATION/CONSEQUENCES

a. This project is necessary to bring this site-specific collection to Standards as required by NPS-28, Cultural Resources Management Guideline, the NPS Museum Handbook, and the revised Special Directive 80-1.

b. The benefits will be the adequate documentation, care and preservation of this site-specific collection of ______objects.

c. Problems to be solved are the current documented deficiencies in the management and preservation care of these site-specific collections.

d. The effects of not funding will be the continued mismanagement and deterioration of site specific cultural resources and natural history specimens.

PLANNING AND MANAGEMENT REQUIREMENTS *(Follow instructions and outline provided in Program Formulation Guideline)*

BACKGROUND AND STATUS

There are approximately ____accessions in the park's collections, comprising some artifacts and specimens of scientific, cultural and monetary value to the National Park Service. The collections are composed of a diverse range of objects in terms of types, material and state of preservation, and thus pose a series of unique problems in providing adequate storage, care, and use. This Plan will allow the park to respond to the unique requirements of this collection, thus preventing continued deterioration and loss.

ORIGINATOR (Signature and Title)	DATE	CONCURRENCE (Signature of Superintendent or Equivalent Official)	DATE

APPROVAL (Signature of Regional Director or Equivalent Official)	DATE

APPENDIX A. MANDATES AND STANDARDS FOR NPS MUSEUM COLLECTIONS MANAGEMENT

APPENDIX A. MANDATES AND STANDARDS FOR NPS MUSEUM COLLECTIONS MANAGEMENT

A. LAWS, REGULATIONS, AND CONVENTIONS

1. Mandate for NPS Museum Collections

The four laws that provide the basic legal mandate for the National Park Service to undertake museum collection management are as follows:

Act for the Preservation of American Antiquities, June 8, 1906 (16 USC 431-433)

Authorizes the President to declare national monuments to protect sites and objects; authorizes Federal departments to grant permits for survey and excavation and to enforce protection of archeological sites and objects under their jurisdiction; and requires that materials excavated be permanently preserved in public museums.

Organic Act of 1916 (16 USC 1 et seq.)

Authorizes the creation of the National Park Service and states its purpose as: "...to conserve the scenery and the natural and historic objects...therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Historic Sites Act of 1935 (16 USC 461-467)

Authorizes the Secretary of the Interior through the National Park Service to preserve and maintain objects of national historical or archeological significance and to "establish and maintain museums in connection therewith."

Museum Properties Management Act of 1955 (16 USC, Sect. 18 [f])
Authorizes the Secretary of the Interior through the National Park Service to acquire collections through donation and purchase and to loan and exchange collections. The complete text of this law is included on page 2 of this section.

An Act To increase the public benefits from the National Park System by facilitating the management of museum properties relating thereto, and for other purposes, approved July 1, 1955 (69 Stat. 242)

Be it enacted by the Senate and House of Representative of the United States of America in Congress assembled, That the purpose of this Act shall be to increase the public benefits from museums established within the individual areas administered by the Secretary of the Interior through the National Park Service as a means of informing the public concerning the areas and preserving valuable objects and relics relating thereto. The Secretary of the Interior, notwithstanding other provisions or limitations of law, may perform the following functions in such manner as he shall consider to be in the public interest:

(a) Accept donations and bequests of money or other personal property, and hold, use, expend, and administer the same for purposes of this Act;

(b) Purchase from such donations and bequests of money museum objects, museum collections, and other personal properties at prices he considers to be reasonable;

(c) Make exchanges by accepting museum objects, museum collections, and other personal properties, and by granting in exchange therefore museum property under the administrative jurisdiction of the Secretary which is no longer needed or which may be held in duplicate among the museum properties administered by the Secretary, such exchanges to be consummated on a basis which the Secretary considers to be equitable and in the public interest;

(d) Accept the loan of museum objects, museum collections, and other personal properties and pay transportation costs incidental thereto, such loans to be accepted upon terms and conditions which he shall consider necessary; and

(e) Loan to responsible public or private organizations, institutions, or agencies, without cost to the United States, such museum objects, museum collections, and other personal property as he shall consider advisable, such loans to be made upon terms and conditions which he shall consider necessary to protect the public interest in such properties (16 U.S.C. s 18f.)

Archaeological Resources Protection Act of 1979 (16 USC 470aa-mm)

This act and its implementing regulation (43 CFR Part 7) define archeological resources to mean any material remains of human life or activities that are at least 100 years of age, and which are capable of providing scientific or humanistic understandings of past human behavior, cultural adaptation and related topics through the application of scientific or scholarly techniques. The act provides for the protection of archeological resources located on public and Indian lands by (1) requiring that a permit be obtained prior to conducting archeological studies, (2) requiring that information on the nature and location of resources remain confidential if its release may harm the resources, and (3) establishing civil and criminal penalties for the excavation, removal or damage of resources without a permit. Materials lawfully acquired prior to the passage of the act are not subject to the penalties. For resources located on public lands, the act requires that materials excavated and associated records be preserved in a suitable repository. The act also gives the Secretary of the Interior the discretionary authority to issue regulations for the proper curation of federally-owned and administered archeological collections.

2. Additional Laws, Regulations, and Conventions

The following laws, regulations, and conventions apply to NPS museum collections:

Cultural Collections

43 CFR Part 3 "Preservation of American Antiquities" (implementing regulations for the Antiquities Act)

Section 3.16 authorizes Federal land managers to seize materials recovered illegally from archeological resources located on lands owned or controlled by the United States, and dispose of the materials by depositing them in the proper national depository or otherwise. Section 3.17 requires that every collection recovered under the Antiquities Act be preserved in the public museum designated in the Antiquities Act permit, and be accessible to the public. The Secretary of the Smithsonian Institution must approve of the transfer of an Antiquities Act collection, which may only be transferred to another public museum, and be accessible to the public. If the repository ceases to exist, the Antiquities Act collection shall revert to the national collections and be in the proper national depository.

American Indian Religious Freedom Act of 1978 (42 USC 1996)

This act reaffirms the constitutional right of "freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use, and possession of sacred objects, and the freedom to worship through ceremonials and traditional

rites." NPS Management Policies (Dec 88) provide guidance on the acquisition and management of museum collections associated with Native Americans. Section B of this appendix provides an excerpt of this policy's statements regarding museum collections.

43 CFR Part 7 "Protection of Archeological resources: Uniform Regulations"

Sections 7.6(b)(5) and (6) require that repositories proposed by ARPA permit applicants to store materials and associated records certify in writing their willingness to assume curatorial responsibility for the collections. For resources located on public lands, the repositories must also certify that they will safeguard and preserve the collections as property of the United States.

Section 7.8(a)(7) requires that ARPA permit applicants certify that, not later than 90 days after the final report is submitted to the Federal land manager, the collections will be delivered to the repository named in the ARPA permit.

Section 7.9(a)(3) requires that Federal land managers specify in ARPA permits the name of the repository in which collections are to be deposited.

Section 7.13(a) states that archeological resources excavated or removed from the public lands remain the property of the United States. Section 7.13(b) states that archeological resources excavated or removed from Indian lands remain the property of the Indian or Indian tribe having rights of ownership over such resources. Section 7.13(c) authorizes the Secretary of the Interior to promulgate regulations for the curation of federally-owned and administered collections. In the absence of such regulations, section 7.13(d) authorizes Federal land managers to provide for the exchange of collections among suitable repositories.

Section 7.18 restates the confidentiality requirement specified in ARPA.

36 CFR Part 79 "Curation of Federally-Owned and Administered Archeological Collections

The regulation (1) sets forth the responsibilities of Federal agencies to manage and preserve collections; (2) identifies methods for Federal agencies to use to secure curatorial services; (3) identifies methods for Federal agencies to fund curatorial services; (4) sets forth terms and conditions for Federal agencies to include in contracts, memoranda, agreements and other written instruments with repositories for curatorial services; (5) establishes standards for Federal agencies to use to determine when a repository has the capability to provide long-term curatorial services; (6) sets forth guidelines for using

collections; and (7) sets forth procedures and guidelines for conducting periodic inspections and inventories of collections.

<u>1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property</u> (implemented in the United States by P.L. 97-446 in 1983, 19 USC 2601)

As one of 60 signatories to the Convention, the United States agrees to work with other nations to prevent the import of and trade in archeological and ethnographic materials (when requested) and in stolen cultural collections. The United States is the only major art-importing country to sign the convention to date. In addition, Canada and Korea are signatories and Australia is seriously considering signing. The convention, which is enforced by the United States Customs Service, includes language which exempts objects imported for temporary exhibits.

The convention provides protection for archeological and ethnological materials when the home nation requests that other signatories not import these materials. To date El Salvador is the only nation to have such a request approved (for pre-Columbian materials from a particular region); Canada's request for such protection is currently under review. Under this provision archeological materials must be "of cultural significance, at least 250 years old and normally discovered as a result of scientific excavation, clandestine or accidental digging, or exploration on land or under water." Ethnographic materials must be "the product of a tribal or nonindustrial society and important to the cultural heritage of a people because of its distinctive characteristics, comparative rarity, or its contribution to the knowledge of the origins, development or history of that people."

The convention also provides protection for stolen property, including cultural and natural history collections, which have been taken from a museum or public institution (including churches, monuments and archeological sites) in a signatory country. To be covered the materials must have been previously inventoried as part of the institution's collection, however.

The nuances of the implementation of the convention are bound to raise questions. Contact the Regional Curator for assistance. Information on this convention may be obtained from:

United States Information Agency
301 4th Street, S.W., Room 247
Washington, D.C. 20547

Direct questions relevant to the laws and regulations on archeology to the Regional Curator and the Regional Archeologist.

Natural History Collections

Lacey Act of 1900 (18 USC 43-44)

This act makes the violation of any state, federal or foreign wildlife law a federal offense and places stipulations on the importing and labelling of wildlife (e.g., birds and mammals) and their parts. It poses complex problems for museums in relation to the acquisition and deaccession of wildlife materials and the sale of wildlife materials in museum shops because it is hard to prove the legal history of such pieces. Enforcement of the Act requires proof of intentional violation, but ignorance of the relevant state, federal or foreign statutes is not excusable. The Black Bass Act of 1930 (16 USC 851) added fish to the list of wildlife under the Lacey Act.

Migratory Bird Treaty Act of 1918 (16 USC 703-711)

Enacted to protect birds flying between the United States and Canada, this Act was later expanded to include Mexico and Japan. It covers all wild, native birds not legally hunted by state law. Some non-native species may be covered by state law and, therefore, the Lacey Act.

This Act makes it illegal to kill, capture, collect, possess, buy, sell, ship, import or export listed species including their parts, nests and eggs. Museums and non-commercial institutions can get permits for legal possession, collection and transportation of objects but permits impose extensive record-keeping requirements. Only museums and other specified institutions can purchase any protected bird or part thereof, and the seller must possess a federal permit for a legal sale.

Bald Eagle Protection Act of 1940 (16 USC 668a)

Amended in 1962 to include golden eagles, this act prohibits taking, buying, selling, trading, possession, importation or exportation of eagles or their parts, nests, eggs or products made of them. It does, however, authorize permits for taking, possessing and transporting eagles and their parts for scientific, exhibition and Indian religious purposes. Possession and transportation ofeagles held since before the act require no permits, but museums need permits for any materials acquired subsequently.

Marine Mammal Protection Act of 1972 (16 USC 1361-1407)

This act places a moratorium on the killing of marine mammals by United States citizens and restricts the possession, sale, purchase, importation or transportation of the animals and their products and parts. Permits are available for exhibiting marine mammals and their parts and for holding them in storage. However, native peoples can use such parts for the manufacture and sale of handcrafts as long as the sale is handled by a licensed dealer.

Museums do not need permits for pre-Act materials or to purchase legitimate handcrafts. However, they should consider obtaining permits for all other marine mammal materials.

Endangered Species Act of 1973, as amended (16 USC 1531-1543)

This act makes it illegal to harass, harm or kill listed species and to use, buy or sell the species or parts thereof in the course of an interstate commercial activity. Intra-state transactions are allowed if pre-Act ownership can be proven.

Although the Act does not apply to fossils and objects greater than 100 years old, age must be meticulously verified. Park museums must have a permit to purchase more recent objects that contain parts of endangered or threatened species.

Gifts of endangered or threatened specimens to museums are allowed if there is proof of pre-Act ownership and if the objects have not been offered for sale since the date of this Act. Loans or gifts between educational institutions are allowed. In such instances permits are not required, even if the objects cross state lines.

36 CFR, Section 2.5 (Revision effective April 30, 1984), "Research Specimens"

Section 2.5(g) states: "Specimen collection permits shall contain the following conditions:

1. Specimens placed in displays or collections shall bear official National Park Service museum labels and their catalog numbers will be registered in the National Park Service National Catalog.

2. Specimens and data derived from consumed specimens will be made available to the public and reports and publications resulting from a research specimen collection permit shall be filed with the superintendent."

50 CFR, Sections 17.11 and 17.12, "Endangered and Threatened Wildlife and Plants."

These annually revised sections provide lists of names of all the species of wildlife and plants determined to be endangered or threatened.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

This worldwide effort to protect endangered species of plants and animals by regulating imports and exports was first ratified in 1977

and had been joined by 50 nations by 1980. It allows for certificates of exemption for the import or export of items acquired before CITES, and for non-commercial exchange between institutions.

The convention deals with three appendices that protect materials of varying degrees of scarcity:

> <u>Appendix I</u>. Species are in danger of extinction and there is no commercial trade in them. Any international transport of these materials requires permits from both the exporting and importing nations.
>
> <u>Appendix II</u>. Species require strict regulation to prevent the danger of extinction and/or look like Appendix I species. Permits for international transport are issued by the exporting nation, and are allowed for any purpose not detrimental to the species.
>
> <u>Appendix III</u>. Species are protected only within their native countries. They require permits for export even if they are plentiful elsewhere.

Direct questions relevant to CITES, the Endangered Species Act and other laws and regulations to the Regional Curator and the Regional Chief Scientist. The U.S. Fish and Wildlife Service, Office of Management Authority acts as a clearinghouse for information on CITES and other wildlife laws, including procedures and applications for obtaining permits to have endangered or threatened wildlife and plants in a park's museum collection for scientific or educational purposes. Address inquiries to:

> U.S. Department of the Interior
> Fish and Wildlife Service
> Office of Management Authority
> P.O. Box 3507
> Arlington, VA 22203-3507
> 703/358-2104

B. NPS MANAGEMENT POLICIES FOR MUSEUM OBJECTS

Excerpts from the NPS Management Policies (Dec 88) that are specifically relevant to museum objects are as follows:

1. Chapter 5 - Cultural Resource Management

Inventories (Page 5:1)

"The following cultural resource inventories will be maintained for the national park system: (1) a List of Classified Structures encompassing historic and prehistoric structures; (2) a Cultural Sites Inventory consisting of both prehistoric/historic archeological resources and ethnographic resources (cultural and natural) associated with contemporary native Americans and other ethnic groups; and (3) a National Catalog of Museum Objects encompassing all cultural and natural history objects in NPS collections."

Preservation of Data and Collections and Protection of Research Potential (Page 5:3)

"Field data, objects, specimens, and features of structures retrieved for preservation during cultural resource research and treatment projects, together with associated records and reports, will be managed within the park museum collection. Where practical, the features of sites and structures will be left in place."

Treatment of Museum Objects (Pages 5:9-10)

"**Preservation.** A museum object will be preserved in its present condition through ongoing preventive conservation if (1) that condition is satisfactory for exhibit or research, or (2) another treatment is warranted but cannot be accomplished until some future time. Interventional measures will be taken when preventive conservation measures are insufficient to reduce deterioration to a tolerable level, or when the object is so fragile as to be endangered under any circumstances. Intervention will be minimized to reduce the possibility of compromising the object's integrity.

Restoration. A museum object may be restored to an earlier appearance if (1) restoration is required for exhibit or research purposes, (2) sufficient data exist to permit restoration with minimal conjecture, and (3) restoration will not modify the object's known original character. Restoration will be accomplished using the techniques and materials that least modify the object and in such manner that the materials will be removable at a later time with minimal adverse effect.

Restored areas will be distinguishable from original material and documented. Restoration will take into account the possible importance of preserving signs of wear, damage, former maintenance, and other historical and scientific evidence.

Reproduction. Museum objects needed for interpretive presentations will be reproduced for such use when the originals are unavailable or would be subject to undue deterioration or loss. The National Park Service will observe copyright laws with respect to reproduction."

Acquisition, Management, and Disposition of Museum Objects (Page 5:10)

"Objects and related documentation essential to achieving the purposes and objectives of the parks will be acquired and maintained in accordance with approved scope of collection statements for each park. Archeological objects systematically collected within a park and natural history specimens systematically collected within a park for exhibit or permanent retention will be managed as part of the museum collection. Museum collection management and care will be addressed at all appropriate levels of planning.

Museum objects will be acquired and disposed of in conformance with legal authorizations and current NPS curatorial procedures. The National Park Service will acquire only collections having legal and ethical pedigrees, and each park will maintain complete and current accession records to establish the basis for legal custody of the objects in its possession. Museum catalog records will be prepared by each park to record basic property management data and other documentary information for museum objects. Objects will be inventoried in accordance with current procedures.

The National Park Service may cooperate with qualified institutions in the management of museum objects and, under existing legal authorities, may loan objects to and exchange objects with such institutions for approved purposes. The National Park Service will repatriate museum objects when lawful and when it can be demonstrated by a native American group that the materials are its inalienable communal property.

Interested persons will be permitted to inspect and study NPS museum objects and records in accordance with standards for the preservation and use of collections and subject to the policies regarding confidentiality of resource data."

Archives and Manuscripts (Pages 5:10-11)

"Archival and manuscript collections are considered museum property and will be managed in ways that preserve them intact for the future while providing current access.

When an archival collection not owned by the National Park Service falls within a park's approved scope of collection statement, every reasonable effort will be made to acquire it if (1) an appropriate storage facility will be provided by the Park Service or a cooperating institution, (2) the facility will be staffed by at least one archivist, curator, librarian, or other person experienced in caring for documentary materials, and (3) the collection will be made

available to serious researchers under conditions that maximize both preservation and use and ensure security against theft and vandalism.

If the foregoing acquisition criteria cannot be met, the National Park Service will encourage transfer or donation of the collection to an appropriate local or regional repository or, in the case of a collection important to a park's administrative history, to the National Park Service History Collection at the Harpers Ferry Center.

Placement of historical documents owned by the National Park Service into repositories managed by others will be subject to the procedures concerning loans of museum property and any conditions of access or other restrictions to which the Park Service may have agreed or is bound by law.

Parks will retain notes or copies of records significant to their administrative histories when they periodically ship their official records to federal record centers."

Environmental Monitoring and Control (Page 5:14)

"When necessary for the preservation of a historic structure or a museum collection, appropriate measures will be taken to control relative humidity, temperature, light, and air quality. When museum objects are housed in a historic structure, an evaluation of the needs of both the collection and the structure will be made before introducing environmental control measures. All areas housing museum objects will be continuously monitored to determine whether appropriate levels of relative humidity, temperature, and light are being maintained."

2. <u>Chapter 4 - Natural Resource Management</u>

Natural Resource Collections (Page 4:4)

"Natural resource collections include nonliving and living specimens and associated field records. If placed in exhibits or retained in permanent collections, nonliving specimens and their associated field records will be cataloged into a park's museum collection. Management standards for such collections are specified in the <u>Cultural Resources Management Guideline</u> (NPS-28) and the <u>Museum Handbook</u>."

Paleontologic Resource Management (Page 4:19)

"....Management actions will be taken to prevent illegal collecting and may be taken to prevent damage from natural processes such as erosion. Protection may include construction of shelters over specimens for interpretation in situ, stabilization in the field, or collection, preparation, and placement of specimens in museum collections. The localities and geologic settings of specimens will be adequately documented when specimens are collected."

3. <u>Chapter 7 - Interpretation and Education</u>

Interpretation and Native Americans (Page 7:5)

"The National Park Service will not exhibit native American disinterred skeletal or mummified human remains or photographs or replicas of them. There will be no display of grave goods or other objects if native Americans who are culturally associated with them object to such exhibit. Associated native American tribes and groups will be consulted to determine the religious status of any object, the sacred nature of which is suspected but not confirmed, before it is exhibited or before any action is taken."

4. <u>Chapter 8 - Use of the Parks</u>

Research and Collection Activities (Pages 8:15-16)

"Research activities by non-NPS personnel that, in the superintendent's judgment, might disturb resources or visitors or that require the waiver of any regulation may be allowed in parks only pursuant to the terms and conditions of an appropriate permit. Scientific collecting activities that involve the removal of plants, animals, minerals, or archeological, historical, or paleontological objects will be allowed only if they are (1) proposed in conjunction with authorized research activities and (2) authorized and conducted in accordance with all applicable legislation, regulations, and guidelines (36 CFR 2.5)."

5. <u>Chapter 9 - Park Facilities</u>

Curatorial Facilities (Page 9:15)

"Park curatorial facilities should be adapted to the needs of each park. They may share space in visitor centers or administrative office buildings or be housed in completely separate buildings; however, incorporation with maintenance facilities should be avoided because of the heightened danger of fire, chemical spills, and similar accidents. Curatorial facilities will meet the collection's special requirements for security, fire suppression, and environmental controls."

6. <u>Chapter 10 - Concessions Management</u>

Merchandise and Handcrafts (Pages 10.8-9)

"Concessioners may not sell merchandise that violates conservation principles. The sale of original prehistoric or historic archeological artifacts or vertebrate paleontologic specimens is prohibited. Clearly labelled replicas of such artifacts and specimens may be sold. More detailed definitions of handcrafts and of prohibited items are contained in the <u>Concessions Management Guideline</u>."

C. NPS SERVICEWIDE STANDARDS FOR MANAGING MUSEUM OBJECTS

The following standards, excepted from NPS-28, Cultural Resources Management Guideline, A Manager's Guide, apply to museum collections and archival materials located in parks, archeological and preservation centers, and other NPS organizational units:

Museum Objects

- Each unit must prepare an acquisition planning document called a Scope of Collection Statement that defines the purpose, extent, and use of a museum collection. This document shall be based on a unit's mission and on appropriate legislative mandates. If a unit has no museum collection, a Scope of Collection Statement must be prepared stating this fact.

- Museum objects and associated records generated by systematic research projects within a park's boundaries must be addressed in the Scope of Collection Statement, and must be accounted and cared for in accordance with current NPS curatorial policies and procedures.

- All records associated with a collection of objects or specimens generated by a systematic research project shall be managed as archival material. These records shall be accounted for in accordance with current NPS museum records policies and procedures.

- A Collection Management Plan should be prepared to assist each unit in the proper management and care of its museum collections. A Collection Management Plan shall be prepared by a team of museum professionals from outside the unit and shall be tailored to assist a unit in solving its unique curatorial problems.

- Every museum object must be accessioned as soon as it is in NPS custody, with the registration data recorded and the object numbered in accordance with the current NPS museum records policies and procedures. Full catalog data should be provided on objects, to the extent that the data is obtainable. Accession files, which contain legal proofs of ownership, and catalog records shall be stored in locked, fire-resistant cabinets or vaults located in a physically secure area.

- All collections from systematic research projects associated with the same accession shall be kept at the same repository, except when on temporary loan for specific use elsewhere. Specific objects shall be kept separate as necessary for security, fiscal control, or exhibit.

- Museum objects shall be inventoried periodically, in accordance with current NPS museum property procedures.

- Museum objects shall be exhibited and stored according to the specific environmental needs and vulnerabilities of individual objects. Preventive conservation measures shall include monitoring and controlling light levels, relative humidity, temperature, airborne pollutants, and biological infestations. Preventing or retarding

deterioration will also entail proper housekeeping procedures, adequate security measures, and the careful handling, packing, and transporting of museum objects. Environmental controls and security and fire protection systems appropriate to the collection, and the structure in which it is housed shall in installed.

- Each unit should periodically examine the condition of museum objects in storage and on exhibit to detect evidence of deterioration. If evidence of deterioration is noted, each unit shall take necessary action to ensure that problems are corrected.

- A Collection Condition Survey shall be conducted by a professional conservator to assist a unit in detecting problems with the condition of museum objects and in determining conservation treatment priorities.

- Conservation treatment which intervenes in any way with the form or substance of a museum object shall be kept to the minimum necessary and to satisfy treatment goals. Conservation treatment must be both necessary and appropriate for the particular object in question, according to its preservation needs, history, significance, and role in the museum collection. Conservation treatments must be performed in accordance with the Code of Ethics and Standards of Practice of the American Institute for Conservation of Historic and Artistic Works.

- Museum objects, including significant and high-value reproductions, shall be prioritized as to their importance and value to the unit when developing an Emergency Operations Plan. The Emergency Operations Plan shall give priority of protection and recovery to the most valuable/ significant objects in the museum collection.

- Appropriate uses of museum collections include exhibits, research, and other interpretive media (e.g., publications based on museum objects). Any consumptive use that is likely to damage or hasten the deterioration of museum objects shall be avoided. Each unit shall have a written museum collections access statement.

- Museum objects that are not relevant to a unit, as determined by a Scope of Collection Statement, should be deaccessioned according to current NPS policies and procedures. Archeological and natural history collections systematically collected from within a park's boundaries must not be deaccessioned, except if they have been lost or have deteriorated to such an extent that they no longer have scientific value.

- Curators and others with collections management responsibilities, in addition to the standards of conduct that govern their activities as employees of the Department of the Interior, are expected to adhere to the Code of Ethics for Curators, as formulated by the Curators Committee of the American Association of Museums.

- Native Americans shall be consulted about the propriety of displaying archeological and ethnographic materials while exhibits are in the planning stage. Park consulting plans shall provide guidance on selecting Native American consultants.

Archival Materials

- Archival materials are historic documents, important for their association with historic events, persons, or activities. They are managed as museum objects according to procedures outlined in the NPS Museum Handbook, Part II, Appendix D. Field data and associated records or natural science studies, and historic architecture, and archeological investigations are also treated as archival materials. Official records (those produced by the agency in its day-to-day operations) are managed according to "NPS-19: Records Management Guideline." Books and other library materials used as historic furnishings must be treated as museum objects, subject to museum documentation and care.

- Acquisition of archival material must be compatible with a park's Scope of Collection Statement and must be in accordance with NPS "Management Policies."

- Original archival materials must be preserved; however, the information they contain may be copied and accessioned into the library.

- NPS security and conservation standards for museum objects apply to all archival materials.

D. MANDATE AND POLICY FOR NPS INTEGRATED PEST MANAGEMENT PROGRAM

1. Law and Regulations

   The Federal Insecticide, Fungicide, and Rodenticide (FIFRA) Act of 1947, as amended, and the Federal Code of Regulations (40 CFR) govern pesticide registration, pesticide usage, the training and certification of pesticide applicators, and the criminal and civil penalties associated with the misuse of pesticides. FIFRA also delegates the enforcement of the provisions of the law to the states. In addition, each park should become familiar with the state laws governing pesticide usage.

2. Presidential Memorandum

   The memorandum from the President, August 2, 1979, that directs federal agencies to establish an Integrated Pest Management Program reads as follows:

Memorandum for the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Defense the Secretary of Health Education, and Welfare, the Secretary of Housing and Urban Development, the Secretary of the Interior, the Secretary of Labor, the Secretary of Transportation, the Administrator of the Environmental Protection Agency, the Administrator of the General Services Administration, the Chairman of the Council on Environmental Quality

In my Environmental Message of August 2, 1979, I recognized that integrated pest management (IPM) has both economic and environmental benefits and should be encouraged in both research and operational programs of federal agencies. Therefore, I am directing that each of your agencies:

- Modify as soon as possible your existing pest management, research, control, education, and assistance programs to support and adopt IPM strategies wherever practicable within the limits of existing resources.
- Review your pest management research, control, education, and assistance programs to assess the potential for increased emphasis on integrated pest management.
- Report actions taken to implement IPM strategies and the results of this review and assessment to the IPM coordinating committee in six months.

I am establishing an interagency IPM Coordinating Committee to assure implementation of this directive and to oversee further development and implementation of integrated pest management practices. The Committee shall be chaired by the Council on Environmental Quality. Your agency should appoint one representative to serve on this Committee who is an Assistant Secretary, Assistant Administrator, or the equivalent. The Committee is to report to me by June 30, 1980 on progress made by federal agencies in the advancement of IPM and on any institutional barriers thereto. The Committee may request any Executive agency to furnish such information, advice, and service as may be useful for the fulfillment of the Committee's functions. Each of your agencies shall cooperate with and furnish support to the Committee as needed to carry out its functions.

Please give these assignments your immediate attention.

JIMMY CARTER

August 2, 1979

3. Departmental and Service Policy

The Departmental Manual, Part 517, Chapter 1 outlines the pesticide use policy of the Department of the Interior. It is the policy of the Department

> "To use pesticides only after full consideration of alternatives - based on competent analyses of environmental effects, safety, specificity, effectiveness, and costs. The full range of alternatives including chemical, biological, and physical methods, and no action will be considered. When it is determined that a pesticide must be used in order to meet important management goals, the least hazardous material that will meet such goals will be chosen."

The NPS Management Policies (Dec 1988), Chapter 5, Cultural Resources Management provides additional policy guidance:

> **Pest Management** (Page 5:14)
>
> "The National Park Service will follow the integrated pest management approach in addressing pest problems related to cultural resources. All feasible nonchemical methods will be exhausted before resorting to the use of chemicals. Any use of pesticides for cultural resources will conform to the NPS pesticide use policy." (See Pests 4:13-14)

4. NPS-77, Natural Resources Management Guideline, Chapter 2 provides guidance on the NPS Integrated Pest Management Program including certification of pesticide applicators and the procedures for obtaining approval to use pesticides such as museum fumigants.

APPENDIX B. NATIONAL PARK SERVICE APPLICATION PROCEDURES FOR ACCREDITATION OF PARK MUSEUM OPERATIONS BY THE AMERICAN ASSOCIATION OF MUSEUMS (Revised 1987)

APPENDIX B. NATIONAL PARK SERVICE APPLICATION PROCEDURES FOR ACCREDITATION OF PARK MUSEUM OPERATIONS BY THE AMERICAN ASSOCIATION OF MUSEUMS Revised 1987)

A. INTRODUCTION

Purpose: Accreditation provides review and recognition of a park's museum programs by the museum profession, and offers the opportunity for critical self-evaluation. It provides an evaluation according to widely accepted standards of the museum profession. The public recognition that accreditation also provides will facilitate fund raising to support park museum operations.

Background: When Independence NHP was accredited in June 1985, the accreditation team also reviewed the museum-related functions in the Washington Office, two representative Regional Offices (Mid-Atlantic and National Capital Regions), and Harpers Ferry Center. This Servicewide review will facilitate future American Association of Museums accreditation reviews in individual parks because reviewers will not need to examine Servicewide policies and procedures again in detail.

Estimated Time Required: Two years

Funding: Appropriated funds, donated funds and cooperating association funds may be used to pay accreditation fees.

Reference: For further information on the AAM accreditation process, obtain a copy of the publication Accreditation: A Handbook for the Visiting Committee. Washington, D.C.: American Association of Museums, 1989 from:

Director of Accreditation
American Association of Museums
1225 Eye Street, NW
Washington, DC 20005
(202) 289-1818

B. NPS APPLICATION PROCEDURES FOR AAM ACCREDITATION

Step 1: Consult with the Regional Curator, who assesses the park's readiness to apply for accreditation. In this preliminary assessment the park is evaluated according to Servicewide policies, with emphasis on the following requirements:

1. All museum objects are accessioned.

2. All museum objects are cataloged or programmed for cataloging at least to the Registration Data Level, as prescribed in NPS Museum Handbook, Part II.

3. Collections are adequately stored, secured, and protected by fire detection and suppression systems or deficiencies are programmed for correction as required by Special Directive 80-1, Guidance for Meeting NPS Preservation and Protection Standards for Museum Collections.

4. An approved Scope of Collection Statement is in effect.

5. Exhibits are relevant and adequately maintained.

   If the park does not meet the above requirements, it should program to correct deficiencies and repeat Step 1.

   At any point in this process, deficiencies may be identified and the park will need to correct those deficiencies before proceeding to the next step.

Step 2: The Park requests, in writing, approval from the Regional Director to apply for accreditation.

Step 3: The Regional Director, upon the recommendation of the Regional Curator, grants approval to apply for accreditation, or points out the park's deficiencies. The park obtains application forms and information from the American Association of Museums.

Step 4: The park, after consultation with the Regional Curator, submits the application form, a copy of the Regional Director's approval, and the initial application fee ($200) and annual accreditation fee ($150) to the Accreditation Program, American Association of Museums (AAM).

Under the fee structure introduced on May 15, 1987, an annual fee of $150 is assessed as long as a park is in the accreditation program (accredited or being considered for accreditation). The fee is payable each year upon receipt of an invoice from the AAM.

Parks participating in the accreditation program under a previous fee structure will have their fees paid to date prorated and credited according to the new fee structure. The

AAM will provide each park that paid fees under a previous structure with an account statement and an indication of when the park will need to start paying the annual fee of $150.

Supplemental self-study guides and review criteria are used for historic sites, art centers, science and technology centers, planetariums, arboretums, botanical gardens, nature centers, zoos, and aquariums. The park should check with the AAM accreditation staff, prior to submitting the initial application form, about its need for supplemental materials.

Step 5: The park receives the guide to self-study from the AAM and, in consultation with the Regional Curator, completes and submits it, with supporting documents, to the AAM within one year of submitting the application.

Step 6: The AAM Accreditation Commission reviews the guide to self-study and determines one of the following:

1. Interim Approval

2. Tabling for specific deficiencies to be corrected within 6 months or 1 year.

3. Tabling for further information (until the next meeting of the Commission).

4. Denial, with option of appeal.

Step 7: The park works with the Regional Curator and the AAM staff to select a Visiting Committee from the AAM roster of surveyors.

Step 8: The Accreditation Visiting Committee visits the park. Cost: The park pays travel and per diem for the Visiting Committee (usually two individuals within the park's geographic region; occasionally a larger committee may be needed if the Regional Office needs to be visited or if the park is large.)

Step 8a: The Accreditation Visiting Committee visits the Regional Office if the park is first in the Region to apply for accreditation, or if ten years have passed since the Regional Office was visited. Cost: The Regional Office pays travel and per diem for the Visiting Committee.

In order to assess a park within the context of the total organization, park accreditation requires that the appropriate Regional Office also be evaluated at least once every ten years. Review of the Regional Office involves review of all functions that provide support to the museum program, including administration, resource management, interpretation, etc. The Visiting Committee will identify, with the Regional Office, the functional areas to be reviewed.

Step 9: The Visiting Committee submits its report to the AAM Accreditation Commission.

Step 10: The Accreditation Commission reviews the report and recommends one of the following:

1. Accreditation (usually for ten years, but can be granted for only five if the Commission has reservations)

2. Tabling for specific deficiencies to be corrected, within 6 months or 1 year.

3. Tabling for further information (until the next meeting of the Commission).

4. Denial, with option of appeal.

Step 11: Each accredited museum will complete an annual report for submission to the Accreditation Commission. (The required format is distributed by the AAM.)

Step 12: On a cycle of ten (or five) years, as specified at the time of accreditation, the park is notified by the AAM accreditation staff that its accredited status is to be reviewed. Review of accredited status involves Steps 5-10. Cost: Visiting Committee costs in Step 8.

APPENDIX C. PROFESSIONAL ORGANIZATIONS AND SOCIETIES

APPENDIX C. PROFESSIONAL ORGANIZATIONS AND SOCIETIES

A. ORGANIZATIONS AND SOCIETIES

There are several organizations and societies that are involved in various aspects of museum work. This section provides a list of the major organizations and societies in the United States that provide professional guidance to individuals and institutions in the various functions of museum and archival work:

1. American Association of Museums
   1225 Eye Street, NW
   Suite 200
   Washington, DC 20005
   202/289-1818

   The American Association of Museums (AAM), founded in 1906, addresses the concerns of the country's museum community as a whole and represents art and natural history museums, zoos, botanical gardens, arboretums, planetariums, science and technology centers, nature centers, children's museums, and historic museums, sites and societies. Members include museum directors, curators, registrars, educators, marketing and development directors, public relations personnel, and others. The AAM's Accreditation Program (Refer to Appendix B) has long been a leader in establishing professional standards for museums and museum professionals. Publications include a bi-monthly journal, Museum News, and a monthly newsletter Aviso. The AAM Bookstore stocks publications that address such topics as collections management, museum ethics, conservation, marketing, and fund raising. The association holds an annual meeting. Write or call the association for information on membership, publications available through its bookstore, and other programs of the association.

2. American Association for State and Local History
   172 Second Avenue, North
   Suite 102
   Nashville, TN 37201
   615/255-2971

   The American Association for State and Local History (AASLH) is a national non-profit organization that serves agencies and people who work to preserve and interpret history, including historical societies, museums, historic sites, park, libraries, archives, historic preservation organizations, and schools and colleges. In recent years this association has been instrumental in organizing the forum on "A Common Agenda for History Museums." Publications include a bimonthly magazine, History News and a monthly newsletter, History News Dispatch. The association's extensive sales program provides publications and educational materials (e.g., books, technical leaflets, reports, slide-tape and video programs) on the documentation, preservation and interpretation of history, including the

care and conservation of museum objects. The association sponsors seminars, workshops, and an annual meeting. Write or call the association for information on membership, publications available through the sales program, and other programs of the association.

3. Society of American Archivists
600 South Federal Street
Suite 504
Chicago, IL 60605
312/922-0140

The Society of American Archivists (SAA), founded in 1936, promotes the preservation and use of records materials (e.g., manuscripts, films, maps, photographs, sound recordings, and machine readable records. This society provides a wide range of educational workshops, maintains an active publications program, and promotes cooperation, growth, and development in the archival field. Publications include a quarterly journal, American Archivist, and a bimonthly newsletter, SAA Newsletter. The SAA's publication program offers basic manuals on the arrangement, description, access, conservation and care, and exhibiting archival collections. The society sponsors an annual meeting. Write to or call the society for membership information, a catalog of sales publications, and other programs of the society.

4. Society for the Preservation of Natural History Collections
5800 Baum Boulevard
Pittsburgh, PA 15206-3706
412/665-2615

The Society for the Preservation of Natural History Collections (SPNHC), founded in 1958, represents the interests of natural history collections and the people associated with the management and care of these collections. Membership includes individuals within the fields of anthropology, botany, geology, paleontology, zoology and others interested in the development and preservation of natural history collections. Publications include a journal, Collection Forum, and a newsletter, SPNHC Newsletter. The journal, published twice a year, provides up-to-date technical and documentary information on the care of natural history collections. The society conducts annual meetings that include formal presentations, and workshops. Write to or call the society's treasurer for information on membership.

5. American Institute for Conservation of Historic and Artistic Works
1400 16th Street, NW
Suite 340
Washington, DC 20036
202/232-6636

The American Institute for Conservation of Historic and Artistic Works (AIC) addresses the concerns of the conservation profession. Members include conservators who practice in all of the material specialties (e.g., paintings, books and paper, textiles, wood,

photographic materials, and objects of leather, ceramic, glass, and stone) and conservation scientists. Librarians, archivists, and curators may also be members. This organization has adopted and published "A Code of Ethics and Standards of Practice" for the conservation profession in the United States (Refer to Appendix D). Publications include a biannual journal, Journal of the American Institute for Conservation and a bimonthly newsletter, AIC Newsletter. The newsletter includes information from the various specialties, health and safety updates, preventive conservation information, and a list of conferences, courses, and seminars. The association sponsors an annual meeting including a pre-meeting workshop. The association also maintains an annual directory of its membership. Write to or call the association for membership information.

6. Regional and State Museum Conferences and Associations

There are several regional museum organizations that are under the auspices of the American Association of Museums. These conferences include the New England Museum Association, the Mid-Atlantic Museum Association, Southeastern Museums Conference, the Midwest Museums Conference, the Mountain-Plains Museums Association, and the Western Regional Conference. These regional associations sponsor annual workshops and meetings for their membership. Contact the Regional Curator or write to or call the American Association of Museums for a current list of addresses for these regional associations.

7. Regional Conservation Guilds and Associations

There are several regional conservation associations located throughout the country. These groups usually hold monthly meetings that address special topics in conservation including museum environment and other preventive conservation issues. Contact the Regional Curator or write to or call the American Institute for Conservation for a current list of the names and addresses of these regional associations.

B. MUSEUM JOURNALS AND TECHNICAL PUBLICATIONS

This section provides information on journals and technical publications that may be pertinent to the park's museum collection.

1. ASC Newsletter

   This newsletter, printed bimonthly (February, April, June, August, October, and December) is available by subscription from the Association of Systematics Collections (ASC). The newsletter contains articles on systematic natural history collections, as well as brief notes on funding sources, meetings and conferences, and book reviews. For information on subscribing to this newsletter, write or call:

   Association for Systematics Collections
   730 11th Street, NW
   Second Floor
   Washington, DC 20001-4584
   202/347-2850

2. Curator

   Curator, the quarterly publication of the American Museum of Natural History, is available by annual subscription. This journal provides timely articles on philosphical directions in the museum profession, documentation and care of museum collections, and specific articles on solving storage and exhibit problems. For information on subscribing to this journal write to:

   Curator
   Subscription Service
   P. O. Box 3000
   Dept. HHH
   Denville, NJ 07834

3. Canadian Conservation Institute (CCI/ICC) Notes and Newsletter

   The Canadian Conservation Institute (CCI) publishes a series of technical notes (similar to NPS Conserve O Grams) on museum collections care topics (e.g., the museum environment; disaster management; equipment; and techniques of caring for specific types of objects, including paintings, leather, skin, ethnographic materials, textiles, photographic materials. A complete set of these technical notes can be obtained from the institute by writing to the below address. The Institute's Bulletin is also available upon request. For information on obtaining the notes and the newsletter, write to:

   Canadian Conservation Institute
   1030 Innes Road
   Ottawa, Ontario
   Canada K1A 0C8
   613/998-3721

C. FUNDING ORGANIZATIONS

The park's cooperating association may apply for Federal funding for a museum collections project on behalf of a park. Consult with the Regional Curator. Parks should write to the below listed organizations for further information on the types of grants that are available:

Institute of Museum Services
1100 Pennsylvania Avenue, NW
Washington, DC 20506
202/786-0539

National Endowment for the Arts
1100 Pennsylvania Avenue, NW
Washington, DC 20565
202/682-5400

National Endowment for the Humanities
1100 Pennsylvania Avenue, NW
Washington, DC 20565
202/786-0438

The J. Paul Getty Trust provides grants to institutions for the conservation of art collections, including surveys to determine the condition and conservation needs of such collections. Parks with art collections may apply directly to the Trust for such grants. Write to the following address for information on this funding program:

The Getty Grant Program
401 Wilshire Boulevard
Suite 1000
Santa Monica, CA 90401-1455
213/393-4244

For a list of other foundations that provide grants to museums consult The Foundation Directory, published by the Foundation Center located in New York City. For a copy of this directory, write to the following address:

Foundation Center
888 Seventh Street
New York, NY 10019

APPENDIX D. CODE OF ETHICS FOR CURATORS, ARCHIVISTS, AND CONSERVATORS

APPENDIX D. CODE OF ETHICS FOR CURATORS, ARCHIVISTS, AND CONSERVATORS

A. AMERICAN ASSOCIATION OF MUSEUMS CODE OF ETHICS FOR CURATORS

In June 1982, the curators' committee of the American Association of Museums (AAM) formally adopted its code of ethics. This document was created to serve as a reference guide for museum curators and people who deal with museum collections, and to protect curators and institutions when there are allegations of unethical behavior. All NPS employees with collections management responsibilities are expected to adhere to this Code as stated in the NPS Standards for Managing Museum Objects, Cultural Resources Management Guideline (NPS-28), A Manager's Guide. Refer to Chapter 1, Section F of this handbook for a discussion of NPS standards of conduct for curatorial staff.

The Code establishes standards for appropriate curatorial behavior and identifies critical, frequently controversial issues: acquisition and disposal, appraisals, personal collecting, buying and selling, field collecting, ownership of scholarly materials, and the broader area of conflict of interests. A reprint of this code should be obtained from the American Association of Museums and inserted in this section. It should be reviewed periodically, and kept close at hand for ready reference.

B. SOCIETY OF AMERICAN ARCHIVISTS CODE OF ETHICS FOR ARCHIVISTS

A Code of Ethics for Archivists has been prepared by the Society of American Archivists (SAA). A copy of this code of ethics is reprinted in this appendix by permission of the Society of American Archivists.

Society of American Archivists
A CODE OF ETHICS FOR ARCHIVISTS

Archivists select, preserve, and make available records and papers that have lasting value to the organization or public that the archivist serves. Archivists perform their responsibilities in accordance with statutory authorization or institutional policy. They subscribe to a code of ethics based on sound archival principles and promote institutional and professional observance of these ethical and archival standards.

Archivists arrange transfers of records and acquire papers in accordance with their institutions' purposes and resources. They do not compete for acquistions when competition would endanger the integrity or safety of records and papers; they cooperate to ensure the preservation of these materials in repositories where they will be adequately processed and effectively utilized.

Archivists negotiating with transferring officials or owners of papers seek fair decisions based on full consideration of authority to transfer, donate, or sell; financial arrangements and benefits; copyright; plans for processing; and, conditions of access. Archivists discourage unreasonable restrictions on access or use, but may accept as a condition of acquisition clearly stated restrictions of limited duration and may occasionally suggest such restrictions to protect privacy. Archivists observe faithfully all agreements made at the time of transfer or acquisition.

Archivists appraise records and papers with unpartial judgment based on thorough knowledge of their institutions' administrative requirements or acquisitions policies. They arrange records and papers selected for retention in conformity with sound archival principles and as rapidly as their resources permit. Archivists protect the integrity of records and papers in their custody, guarding them against defacement, alteration, theft, and physical damage, and ensure that their evidentiary value is not impaired in the archival work of restoration, arrangement, and use. They cooperate with other archivists and law enforcement agencies in the apprehension and prosecution of thieves.

Archivists respect the privacy of individuals who created or are the subjects of records and papers, especially those who had no voice in the disposition of the materials. They neither revel nor profit from information gained through work with restricted holdings.

Archivists answer courteously and with a spirit of helpfulness all reasonable inquiries about their holdings, and encourage use of them to the greatest extent compatible with institutional policies, preservation of holdings, legal considerations, individual rights, donor agreements, and judicious use of archival resources. They explain pertinent restrictions to potential users, and apply them equitably.

Archivists endeavor to inform users of parallel research by others using the same materials, and, if the individuals concerned agree, supply each name to the other party.

Archivists may use their institutions' holdings for personal research and publication if such practices are approved by their employers and are made known to others using the same holdings. Archivists may review and comment on the works of others in their fields, including works based on research in their own institutions. Archivists who collect manuscripts personally should not compete for acquisitions within their own repositories, should inform their employers of their collecting activities, and should preserve complete records of personal acquisitions.

Archivists avoid irresponsible criticism of other archivists or institutions and address complaints about professional or ethical conduct to the individual or institution concerned, or to a professional archival organization.

Archivists share knowledge and experience with other archivists through professional activities and assist the professional growth of others with less training or experience.

Archivists work for the best interests of their institutions and their profession and endeavor to reconcile any conflicts by encouraging adherence to archival standards and ethics.

C. AMERICAN INSTITUTE FOR CONSERVATION CODE OF ETHICS AND STANDARDS OF PRACTICE FOR CONSERVATORS

The Code of Ethics and Standards of Practice of the American Institute for Conservation of Historic and Artistic Works (AIC) provides guidance to conservators in the ethical practice of conservation. Professional associates and fellows of AIC agree to abide by the Code of Ethics and Standards of Practice. However, NPS policy extends the application of these principles and procedures to all conservation treatments, regardless of a practitioner's professional status or affiliations. With the permission of the American Institute of Conservation, a copy of the Code of Ethics for Conservators is included in this section. Much of the material in this Code of Ethics and Standards of Practice is discussed in the various sections of Chapter 8.

Part One - Code Of Ethics consists of statements of basic principles. There are "obligations to historic and artistic works", as well as responsibilities in professional relationships with other people.

The list of "obligations" begins by stating the following fundamental principle: **"All professional actions of the conservator are governed by unswerving respect for the esthetic, historic and physical integrity of the object."** The conservator should attempt to find and use techniques and materials that leave objects intact and uncompromised as much as possible, and preserve the features that characterize them as esthetic, historic, or scientific objects. The other "obligations" follow from this principle. The "single standard", for example, states that treatment should always be "consistent with the conservator's respect for the integrity of the objects", regardless of the value of the objects, the number being treated, or the extent of treatment that is appropriate in the circumstances.

Part Two - Standards of Practice outlines appropriate procedures for carrying out scientific analytical studies of objects and for documenting, examination and treatment, including what is required in contractual relationships. Safety concerns, for both conservators and objects, are also covered.

Code of Ethics and Standards of Practice

Introduction

The first formulation of a code of ethics for art conservators, adopted by the members of IIC-American Group (now AIC) at the annual meeting in Ottawa, Ontario, Canada, on May 27, 1967, was produced by the Committee on Professional Relations: Sheldon Keck, Chairman; Richard D. Buck; Dudley T. Easby; Rutherford J. Gettens; Caroline Keck; Peter Michaels and Louis Pomerantz.

The first formulation of standards of practice and professional relationships by any group of art conservators was produced by the IIC-American Group (now AIC) Committee on Professional Standards and Procedures, under the direction of Murray Pease, Conservator, Metropolitan Museum of Art. Other members of the committee were Henri H. Courtais, Dudley T. Easby, Rutherford J. Gettens and Sheldon Keck. The report was adopted by the IIC-AG at the annual meeting of the group in New York on June 8, 1963. It was published in *Studies in Conservation*, Vol. 9, No. 3, August 1964, pp. 116-121. The primary purpose of this document was to provide accepted criteria against which a specific procedure or operation can be measured when a question as to its adequacy has been raised.

The responsibility of revising and updating the original code of ethics and standards of practice and professional relationships was assigned to the AIC Committee on Ethics and Standards: Elisabeth C.G. Packard, Chairman; Barbara H. Beardsley; Perry C. Huston; Kate C. Lefferts; Robert M. Organ and Clements L. Robertson.

The original format has been retained except that the more general *Code of Ethics* has been placed first at Part One, followed by the *Standards of Practice* as Part Two.

The revised versions were adopted by the Fellows of AIC at the annual meeting in Toronto, Canada on May 31, 1979.

Elisabeth C.G. Packard, Chairman
Ethics and Standards Committee, 1977-79

Amended, May 24, 1985

PART ONE—CODE OF ETHICS

I. Preamble

Conservation of historic and artistic works is a pursuit requiring extensive training and special aptitudes. It places in the hands of the conservator* cultural holdings which are of great value and historical significance. To be worthy of this special trust requires a high sense of moral responsibility. Whether in private practice or on the staff of an institution or regional center, the conservator has obligations not only to the historic and artistic works with which he** is entrusted, but also to their owners or custodians, to his colleagues and trainees, to his profession, to the public

* Hereafter in the text the word "conservator" also denotes "conservation scientist" where applicable.

** In this text "he" and related pronouns are used in the classical sense to denote the person, male or female

and to posterity. The following code expresses principles and practices which will guide the conservator in the ethical practice of his profession.

II. Obligations to Historic and Artistic Works

A. Respect for Integrity of Object. All professional actions of the conservator are governed by unswerving respect for the esthetic, historic and physical integrity of the object.

B. Competence and Facilities. It is the conservator's responsibility to undertake the investigation or treatment of a historic or artistic work only within the limits of his professional competence and facilities.

C. Single Standard. With every historic or artistic work he undertakes to conserve, regardless of his opinion of its value or quality, the conservator should adhere to the highest and most exacting standard of treatment. Although circumstances may limit the extent of treatment, the quality of treatment should never be governed by the quality or value of the object. While special techniques may be required during treatment of large groups of objects, such as archival and natural history material, these procedures should be consistent with the conservator's respect for the integrity of the objects.

D. Suitability of Treatment. The conservator should not perform or recommend which is not appropriate to the preservation or best interests of the historic or artistic work. The necessity and quality of the treatment should be more important to the professional than his remuneration.

E. Principle of Reversibility. The conservator is guided by and endeavors to apply the "principle of reversibility" in his treatments. He should avoid the use of materials which may become so intractable that their future removal could endanger the physical safety of the object. He should also avoid the use of techniques the results of which cannot be undone if that should become desirable.

F. Limitations on Esthetic Reintegration. In compensating for damage or loss, a conservator may supply little or much restoration, according to a firm previous understanding with the owner or custodian and with the artist, if living. It is equally clear that he cannot ethically carry compensation to a point of modifying the known character of the original.

G. Continued Self-Education. It is the responsibility of every conservator to remain abreast of current knowledge in his field and to continue to develop his skills so that he may give the best treatment circumstances permit.

H. Auxiliary Personnel. The conservator has an obligation to protect and preserve the historic and artistic works under his care at all times by supervising and regulating the work of all auxiliary personnel, trainees and volunteers under his professional direction. A conservator should not contract or engage himself to clients as a supervisor of insufficiently trained auxiliary personnel unless he can arrange to be present to direct the work.

III. Responsibilities to the Owner or Custodian

A. Contracts. Contract practice may permit a conservator to enter into an agreement with individuals, institutions, corporations or governmental agencies to provide conservation services, provided that the contract or agreement does not contravene the principles of ethics as laid down or implied in this code.

B. Changes in Treatment or Fee. Any changes on the part of the conservator in the contracted planned procedure in treating historic and artistic works, or changes in the fee which has pre-

viously been estimated should, unless circumstances intervene, be made known to the owner or custodian and be approved in writing before the changes are effected.

C. **Abrogation of Contract.** The conservator should understand that an owner or custodian is free to select, without persuasion or admonition, the services of any conservator of his choice or of more than one conservator simultaneously, and is also at liberty to change from one conservator to another at his own discretion. However, after a contract, oral or written, has been made for the treatment of a specific object, neither the conservator nor the owner may ethically withdraw from it except by mutual agreement.

D. **Proper Course of Treatment.** Inasmuch as an owner may not be competent to judge the conservation requirements of his historic and artistic possessions, the conservator should honestly and sincerely advise what he considers the proper course of treatment.

E. **Report of Examination.** Before performing any treatment on an object, the conservator should first make an adequate examination and record of condition.* The conservator is obliged to report his findings and recommendations to the owner or custodian or their delegate and await instructions before proceeding.

F. **Record of Treatment.** A record of treatment should also be made by the conservator. He has the obligation to record and report in detail to the owner or custodian the materials and methods of procedure employed in treating the object.

G. **Punctuality and Expedition.** It is the obligation of the conservator to estimate the length of time it will take to complete the treatment and to abide by his contract with reasonable punctuality.

H. **Fees.** Fees for conservation service should be commensurate with the service rendered, with due regard for fairness to the owner or custodian and to the conservator and for respect for the profession.

In determining the amount of the fee, it is proper to consider (1) time and labor required, (2) cost of materials and insurance, (3) novelty and difficulty of the treatment, (4) customary charges of others for like services, (5) the problems involved in treating a work of high value, (6) character of the employment-casual or constant client.

An owner's ability to pay cannot justify a charge in excess of the value of the service.

Conservators should avoid charges that overestimate the worth of their services, as well as those that undervalue them.

Because of variations in the treatment of similar conditions, it is impossible to establish with mathematical accuracy a set fee for a particular type of service.

I. **Warranty or Guarantee.** Although the conservator at all times should follow the highest standards and, to the best of his knowledge, the most acceptable procedures, to warrant or guarantee the results of a treatment is unprofessional. This is not to be construed to mean that he should not willingly and freely correct defects or unforseen alterations which, in his opinion, have occurred prematurely following his treatment.

IV. Relations with Colleagues, Trainees and the Profession

* Standard procedures for engaging in and reporting of examination and treatment of historic and artistic works are described in Part Two, Section IV and V.

A. **Contributions to Profession.** A conservator has an obligation to share his knowledge and experience with his colleagues and with serious students. He should show his appreciation and respect to those from whom he has learned and to those who have contributed in the past to the knowledge and the art of the profession by presenting without thought of personal gain such advancements in his techniques of examination and treatment which may be of benefit to the profession. The originator of a novel method of treatment or a new material should make full disclosure of the composition and properties of all materials and techniques employed. The originator is expected to cooperate with other conservators and conservation scientists employing or evaluating the proposed methods or materials. None of the above is intended to infringe upon the proprietary rights of the originator.

B. **Trainees and Interns.** The conservator, private or institutional, has a responsibility to undertake the training and instruction of apprentices, trainees and interns, but only within the limits of his expert knowledge and the technical facilities available. The rights and objectives of both the trainer and the apprentice should be clearly stated and mutually agreed upon in writing, and should include such items as anticipated length of apprenticeship, areas of competence to be taught and payments.

C. **References.** A conservator should not recommend or provide a reference for a person applying for a position as a professional conservator unless the conservator unless the conservator has personal knowledge that the applicant's training, experience and performance qualify him for the position.

D. **Intermediaries.** The professional services of a conservator should not be controlled or exploited by any agency, personal or corporate, that intervenes between client and practitioner; the conservator's responsibilities and qualifications are individual and personal. He should avoid all relationships that direct the performance of his duties by or in the interest of such intermediary. This does not preclude his working under the direction of another qualified conservator, whether in private practice or within an institutional system.

E. **Request for Consultation.** If, for any reason, before or during treatment the owner or custodian desires another opinion on procedure through consultation with another conservator, this should not be regarded as evidence of lack of confidence and should be welcomed by the conservator.

F. **Consultation.** No person engaged in the profession of conservation can expect to be expertly informed on all phases of examination, analysis and treatment. In instances of doubt there should be no hesitation in seeking the advice of other professionals, or in referring the owner to a conservator more experienced in the particular special problems.

G. **Misuse of Referral in Client-Conservator Relationships.** Where clients have been referred for consultation or treatment, the conservator to whom they have been referred should, unless it was obviously otherwise intended, return the client to the original conservator as soon as possible. Efforts, direct or indirect, in any way to encroach upon the professional employment of another conservator are considered unprofessional.

H. **Fee Splitting.** The payment of a commission or fee to another conservator or any other person for the reference of a client is to be condemned as unprofessional. Division of a fee is only acceptable where it is based on a division of service or responsibility.

I. **Comment on Qualifications of Another Conservator.** It is unethical for a conservator to volunteer adverse judgement on the qualifications of and procedures rendered by another conservator except as such comment shall be to the mutual benefit of all concerned. In expressing an opinion about another practitioner, either voluntarily or at the request of someone outside the profession, the conservator must always conscientiously consider the iniquity of

slander and must scrupulously base his statement on facts of which he has personal knowledge. If his opinion is uncertain or dependent on hearsay, it is more constructive to withhold comment and to recommend instead someone of whom he has no doubt.

V. **Obligations to the Public.**

A. **Education of the Public.** In his relations with the public, the conservator should accept such opportunities as may be presented to educate the public in the aims, desires and purposes of his profession in order that a better popular understanding of conservation may be established. Such presentations should be in accordance with accepted principles of the time.

B. **Safeguarding the Public Interests.** In the interests of the public as well as their own profession, conservators should observe accepted standards and laws, uphold the dignity and honor of the profession and accept its self-imposed disciplines. It is the right of any conservator to give proper advice when it is requested by those seeking relief against negligent or unethical practices. Further, each conservator should do his part to safeguard the public against illegal or unethical conduct by referring the facts of such delinquency to the President of the AIC as described in the Bylaws, Section II, 12.

C. **Expertises.** Although the results of his examination and treatment of historic and artistic works may make it possible for him to contribute knowledge to the history of art and to the verification of the authorship or authenticity of an object, the issuing of paid expertises or authentications may involve conflict of interest and is not an appropriate or ethical activity for a conservator.

D. **Appraisals.** Because of his intimate contact with and knowledge of techniques of fabrication and the physical condition of historic and artistic works, a conservator is often asked to appraise for a fee the monetary value of an object. Since this activity may involve conflicts of interest inconsistent with the profession and since appraising requires other specialized knowledge of market values and conoisseurship, appraisal for a fee is not recommended unless the individual is a professional member of a recognized professional society of appraisers.

E. **Art Dealing.** Engaging in the business of selling or purchasing for profit or acting as a paid or commissioned agent in the sale of historic and artistic works are activities considered to be inconsistent with the professional integrity of conservators.

F. **Advertising.** It is an accepted principle that the foundation of effective advertising is the establishment of a well-merited reputation for professional ability and integrity. Thus it is recommended that conservators limit all forms of notices and communications which may be construed as advertising to the following:

1. Use of such sign or signs which in size, character, working and position reasonably may be required to indicate the entrance of the premises in which the practice is performed;

2. Use of professional cards and letterheads on stationery, bill and receipt forms, indicating only the name, academic degree, Fellowship in AIC, conservation specialty, office address and telephone number. Only Fellows may use the name of AIC;

3. Use of announcements of commencement of practice, change of location or restriction of practice;

4. Use of advertisements in newspapers, magazines and telephone directories, provided that their form and content do not detract from the high professional standards reflected elsewhere in this code of ethics and do not contain comparisons of ability and cost.

G. Solicitation of Clients.

1. It is recommended that solicitations be confined to discreet announcements in newspapers and magazines inviting clients. Direct mailing to individuals, museums and institutions may be construed as an attempt to solicit clients unethically.

2. The judicious distribution of reprints and communications to colleagues is acceptable and an author may honor requests for his articles. Indiscriminate mailing without sufficient reason is construed as an attempt to solicit clients unethically or an attempt to bring undue attention to the author.

H. Statements In the Name of AIC. Individual members of AIC should not present opinions in the name of AIC to outside organizations or individuals.

PART TWO—STANDARDS OF PRACTICE

I. PREAMBLE

The following standards and procedures are approved by AIC as detailed guidelines to professional practice by conservators* in the examination and treatment of historic and artistic works. Such practice is considered to comprise three categories:

A. Examination, treatment and systematic maintenance of historic works, whether by private or institutional conservators;

B. Scientific analytical study of art objects for such purposes as identifying materials, method of construction, modifications by age or other agents, comparison with comparable material;

C. Supplying previously developed reference data which may bear on condition, authenticity, authorship or age of specific objects. This can be either by formal publication or private communication.

II. GENERAL CONSIDERATIONS OF POLICY.

These are broadly applicable to all categories:

A. Professional Attitude. It must be axiomatic that all professional actions of a conservator be governed by unswerving respect for the integrity of historic and artistic works. Such respect is manifest not only in policies of restoration, but in selection of courses of treatment, in safeguarding against accident, protection against loss and strict avoidance of misinterpreting technical evidence.

B. Contractual Relationships. A contract should include the need for a clear written statement of the following: the exact work to be done, the basis for charges, if any, the extent and substance of reports, including photographs as appropriate, responsibility for insurance coverage deemed adequate for operator, owner and object, provisions for safeguarding objects, method of delivery and any subcontracting or reassignment of work.**

C. Assumption of Responsibility. It is a conservator's responsibility to contract for investigation or treatment only to the limits of his professional competence and facilities. Should one

* "Conservators" in the text also denotes "conservation scientists" when applicable.

** It is recommended that a lawyer be consulted.

not be trained or equipped for a full scientific study by generally accepted current technical means, any specific limitations must be stated and accepted by both parties from the beginning. Whenever further opinion seems to be required, such further opinion or opinions are a necessary part of a comprehensive report. In the same manner, a conservator will be held irresponsible if he undertakes to carry out a course of treatment for which he is inadequately trained or equipped.

D. Interpretation of Evidence. An investigator has the obligation to present all the evidence he has developed about an object commissioned to him for study, favorable or otherwise, and also to supply from his professional knowledge a clear exposition of the significance of each part of the evidence. It will be held improper for him to make outright formal declarations as to age, authenticity and the like (which subsequently might form the basis for a claim or legal action) when each declaration exceeds the logical development of the specific evidence.

E. Limits on Esthetic Reintegration. In compensating for losses or damage, a conservator can be expected to carry out little or much restoration according to a firm previous understanding with the owner or custodian and the artist if living. However, he cannot ethically carry compensation to a point of modifying the known character of the original.

F. Outside Activities. It shall be considered inconsistent with the professional integrity of conservators in any of the three categories of procedure to engage in the following outside activities:

1. Issuing paid "expertises" or authentication;

2. Acting as paid or commissioned agent in the selling or purchasing of historic and artistic works;

3. Engaging in such selling or purchasing for personal profit;

4. Appraising for a fee the monetary value of historic and artistic works unless the conservator is a professional member of a recognized professional society of appraisers.

III. PROCEDURE FOR INITIATING, CONDUCTING AND REPORTING IN SCIENTIFIC ANALYTICAL STUDIES OF HISTORIC AND ARTISTIC WORKS.

Whenever it becomes necessary for owners of historic and artistic works to request institutional or commercial analytical laboratories or private consultants to engage in scientific studies of objects for the purpose of developing data which may bear on condition, authenticity, authorship or age of a specific object, the following procedure shall be followed by all parties concerned:

A. Initiating the Study. The owner of the object, or his qualified agent or a qualified officer of an institution, shall send to the examining agency a written request with statements covering the following points as required:

1. The purpose of the study, listing any specific questions to be answered.

2. Whether (a) the whole object of (b) samples from the object are to be made available for study. If samples only are to be sent to the laboratory, the exact location of the samples on the object and the name of the person who took the samples and the date taken are to be given.

3. If the whole object is to be sent to the analyst (a) the legal owner, (b) its value, (c) to what extent it is covered by insurance, (d) by what carrier it is to be sent to the laboratory and

returned to the owner and (e) that the object is to be sent to the investigating laboratory at the owner's risk and expense.

4. Explicit permission to take samples from the object during examination, defining any limitations.

5. Whether the investigator (a) is merely to report facts and observations or (b) if the investigator is expected to draw conclusions from the facts.

6. Whether the laboratory findings are (a) to be kept in strict confidence or (b) whether the findings, regardless of their nature, can be used by the investigator in formal publications and in oral declarations.

7. Whether any of the evidence produced is intended for use in legal proceedings.

B. **Conducting the Study.** The analyst or laboratory official on receiving the object shall:

1. Supply a written receipt to the owner verifying its condition and inform the owner how the object will be stored and guarded.

2. Inform the owner what fees, if any, are to be charged for the analytical services. If there is to be no charge, state that fact explicitly. State also what other charges may be made for photography, radiography and for other analytical services.

3. Make a photographic record of the condition of the object and of any subsequent alteration incurred in the course of the study.

4. Keep a careful and detailed written record of all observations and findings, giving dates.

C. **Preparing and Submitting the Report.** On completion of the investigation, the investigator shall:

1. Render to the owner a typewritten report of his findings with conclusion, if conclusions have been requested. The report shall cover all methods of testing, kind and type of instruments and equipment used and analytical procedures employed in sufficient detail so that, if the owner wishes, the tests can be repeated and checked on the same object by an independent investigator in another laboratory. If it has been necessary, with the owner's permission, to take samples from the object, give location and amount of each sample. Give location and dosage of irradiations (e.g., exposure to X-rays, gamma rays, iridium or other forms of radiant energy).

2. List all other persons who assisted or cooperated in the scientific investigation.

3. List what published works or authorities he has consulted in the course of the study.

4. State what limitations, if any, he may wish to place on the findings. That is, whether or not the findings may be used voluntarily in legal proceedings; whether or not they may be quoted in formal publications or in oral declarations.

IV. PROCEDURE FOR ENGAGING IN AND REPORTING OF EXAMINATION AND TREATMENT OF HISTORIC AND ARTISTIC WORKS BY PROFESSIONAL CONSERVATORS OF INSTITUTIONS AND REGIONAL CENTERS.

A. **Report of Examination.** Such reports shall include in writing the following information:

1. Date of examination and name of examiner.

2. Identification of object with the one referred to in the report by means of photographs, measurements and identification numbers.

3. Descriptions of materials, structure and method of fabrication. Physical, chemical and biological identification of materials composing the object. Statement of method of determination employed or reference to published standard method.

4. Record of alteration and deterioration. Locations and extent of physical defects, chemical alteration and its products, previous repairs and compensation. Statement of method of determination sufficiently detailed to permit duplication by another examiner.

5. Deductions or interpretations of observations and analyses. Comments relative to the degree of alteration.

6. Where evidence indicates forgery, tests which can supply the necessary information on materials and structure shall be employed. After thoroughly checking his results, the examiner shall recommend consultation with one or two disinterested individuals qualified by scientific or art historical training to review the evidence.

B. Proposal for Treatment. Before any treatment is undertaken, a summary or copy of the examination record shall be supplied to the responsible custodian of the object. This shall be accompanied by:

1. A statement of exactly what conditions it is proposed to correct.

2. An outline of the proposed treatment.

3. An estimate of the probable time required for the treatment.

The official custodian's written approval shall be secured before treatment is begun.

C. Report of Treatment. Such report shall include where applicable:

1. A statement of the procedures followed in the current treatment with exact descriptions of materials and methods, including:

   (a) The method by which accretion or deterioration products were removed.

   (b) Method and materials used in correcting distortion in form and shape and in reinforcing, consolidating, stabilizing and protecting structure and surface.

   (c) Kind, extent and location of compensation employed.

2. Photographs, as follows:

   (a) Condition before treatment, with date.

   (b) Photograph in "actual state" without compensation.

   (c) Photograph after treatment, with date.

   (d) Photographs as required to supply data about structure, method of fabrication and state of object as revealed during process of treatment. Photographs or diagrams which clarify method of reconstruction or compensation.

V. CONTRACTUAL PROCEDURES APPLYING TO EXAMINATION AND TREATMENT OF HISTORIC AND ARTISTIC WORKS BY PRIVATE PROFESSIONAL CONSERVATORS.

These do not differ from those applying to institutional conservators except in the fields of contractual relations* and assumption of responsibility. Procedures in these fields shall include:

A. Written proposals stating:

1. Work to be done, estimated charges, and estimated date of completion.

2. Arrangements for insurance and its specific coverage, method of delivery and provisions for safeguarding objects (See VI. B.).

3. Any sub-contract or reassignment of work proposed.

B. A signed contract by the owner or his authorized agent, which may be a signed copy of the letter of proposal.

C. Agreement to give due notice to owner or custodial institution and to receive authorization before objects are removed from operating or storage building to a new location, unless such action is required for emergency or safety reasons.

VI. OPERATING SAFETY PROCEDURES FOR CONSERVATORS.

A. **Safety of Personnel.** All practitioners must follow the latest codes of the appropriate government regulations regarding occupational safety and health.**

1. **Radiation.** X-ray installations and operation procedures and use of radioactive sources should conform to approved specifications. Most state health or labor departments will supply an inspection service to determine the operating safety of radiographic installations.

2. **Toxic Vapors.** Adequate exhaust and ventilation must be a part of all laboratory installations where volatile toxic materials are habitually used. Appropriate vapor respirators should be available at all times.

3. **Mechanical Equipment.** Power tools of all kinds should be provided with adequate light, operating space and safety guards. Their use should be restricted to properly qualified and authorized persons. Cleanliness should be rigidly enforced. Instruments producing dust, abrasive powders and the like should be equipped with positive exhaust systems and operators should be provided with appropriate respirators.

4. **Corrosive Liquids.** Standard laboratory requirements for quantity storage and operating containers of acids, alkalis and other reagents and well as solvents should be rigidly followed. Only authorized personnel should have access to them. Disposal of chemicals should follow approved procedures.

B. **Safety of Historic and Artistic Works** in the laboratory is of paramount importance.

* It is recommended that a lawyer be consulted as to the adequacy of the contract until such time as a standard form be adopted.

** Up-to-date information may be obtained regionally through the United States Government-Labor Department/Occupational Safety and Health-Area Office listed in the telephone directory.

1. **Protection Against Environmental Hazards** such as unsuitable levels of relative humidity, temperature, light and atmospheric pollution (including solvent vapors) should be provided.

2. **Protection Against Theft.** Working and storage areas should be of adequate construction and capable of systematic locking routine. Only authorized personnel should have access.

3. **Protection Against Accidental Damage.**

   (a) Working and storage areas should be adequate for safe handling and storage of objects. Individual storage racks for paintings and shelves for three-dimensional objects should be available. Working equipment should include sturdy, well-designed furniture such as tables, easels, horses.

   (b) Objects should be moved or handled only by experienced persons. Auxiliary personnel should not be permitted to handle objects without adequate training and supervision. They should not engage in activities for which they have inadequate professional training.

   (c) Objects should not be removed from the operating or storage buildings except on due notice and with authorization by the owner or custodial institution, expect when required for safety reasons.

   (d) Transportation and packing of objects should be by approved agencies and according to established methods.

4. **Protection Against Fire**. Adequate precautions should be taken to meet the requirements of the particular insurance underwriter used. Working and storage areas should be equipped with alarm, smoke detection and extinguishing apparatus. Uses to which other parts of the building housing the studio or laboratory may be put should not be of a hazardous nature.

PART THREE—ENFORCEMENT

Upon receipt of evidence of a violation of the *AIC Code of Ethics and Standards of Practice*, the Board of Directors may take any action deemed necessary to protect the integrity of the Institute, pursuant to the violations as referred to in the Bylaws, Section II, 12.

PART FOUR—AMENDMENTS

Amendments or changes in this Code of Ethics and Standards of Practice must be initiated by petition from at least five members who are Fellows or Professional Associates of AIC to the Board of Directors, who will direct the appropriate committee to prepare the amendments for vote. Acceptance into the Code of amendments or changes must be affirmed by at least two-thirds of all AIC Fellows and Professional Associates voting.

APPENDIX E. SCOPE OF COLLECTION STATEMENT

APPENDIX E. SCOPE OF COLLECTION STATEMENT

This appendix contains an example of an approved National Park Service Scope of Collection Statement. It also provides a checklist for evaluating a park's statement.

A. EXAMPLES OF SCOPE OF COLLECTION STATEMENTS

The approved Scope of Collection Statement for Mesa Verde National Park is included in this section to illustrate a complete statement. Contact the Regional Curator for other examples that show how different parks have approached the writing of a Scope of Collection Statement.

MESA VERDE NATIONAL PARK

SCOPE OF COLLECTION STATEMENT

Prepared by:	Elizabeth Bauer Museum Curator	10/16/1989 Date
Recommended by:	Robert C. Hayden Park Superintendent	10/16/1989 Date
Concurred by:	[illegible] Regional Curator	Oct 30, 1989 Date
Approved by: Acting	[illegible] Regional Director	11/16/[illegible] Date

SCOPE OF COLLECTION STATEMENT

Table of Contents

I. INTRODUCTION

This Scope of Collection Statement serves to guide Mesa Verde National Park in the acquisition and preservation of museum objects which contribute directly to the understanding and interpretation of the park's themes and resources. It is also designed to prevent arbitrary and excessive growth of the museum collection.

Mesa Verde is the only national park in the United States whose primary goal is cultural resource protection and preservation. The enabling legislation (34 Stat. 616) which established Mesa Verde National Park on June 29, 1906 states, in part, that the park was established for the

> "...preservation from injury or spoliation of the ruins and other works and relics of prehistoric or primitive man..."

The prehistoric cultural resources of Mesa Verde National Park have received international recognition. The park was selected as a World Heritage Cultural Park on September 8, 1978. It was the first cultural area so designated in the United States. The primary mission is therefore the proper management and preservation of cultural resources for the inspiration, benefit, and edification of the public. It has, however, a secondary mission, to properly manage and preserve the natural resources. The park museum collection meets both interpretive and management needs related to these two missions.

Along with the park's enabling legislation, the National Park Service legal mandates for acquiring and preserving museum collections are contained in the Antiquities Act of 1906 (USC 431-433), the Organic Act of 1916 (USC 1 et seq.), the Historic Sites Act of 1935 (16 USC 461-467), the Museum Properties Act of 1955 (16 USC, Sect. 18[f]), and the Archaeological Resources Protection Act of 1979 (16 USC 470aa-mm).

Many artifacts were removed from the sites presently within park boundaries prior to the establishment of the park, and nearly all of the artifacts recovered during park ruins stabilization projects and archeological excavations conducted before 1923 were placed in the Smithsonian Institution. Efforts to assemble a museum collection within the park began in 1917 when one room of a log cabin, built in 1916 as a ranger station, was converted into a museum by the superintendent. He recognized the need for exhibits of artifacts from the ruins of Mesa Verde. National Park Service support for this museum project consisted of an appropriation of $22.00 for the construction of an exhibit case. The log cabin museum that opened in 1918, was one of the first museums built and operated by the National Park Service. The old log cabin museum was a success and served the public until 1925. It was later dismantled and then reconstructed near the present picnic area on Chapin Mesa. Today it is one of the park's most important historic buildings.

In 1921, Superintendent Jesse L. Nusbaum began an effort to build a large archeological museum on Chapin Mesa to replace the log cabin museum. His requests for support were repeatedly turned down. He finally turned to

private citizens for assistance. Donations from Mrs. Stella Leviston, of San Francisco, and from Mr. John D. Rockefeller, Jr., provided the financial support necessary to build the museum and purchase exhibit cases. The Mesa Verde Archeological Museum was opened to the public in 1925. A major addition was completed in 1936, which gave the building its present form. Today it houses an outstanding collection of archeological objects from the park and adjacent areas. It is an important part of the park interpretive program, and is listed in the National Register of Historic Places.

The Far View Visitor Center, opened to the public in 1969, as a museum, exhibits ethnographic artifacts from Southwest Native American groups. The majority of the material on exhibit was acquired by gift from Mary Jane Colter.

Constructed in 1958 as a laboratory for processing archeological collections, the Mesa Verde Research Center stores the museum collection which is not on exhibit or on loan to other institutions. The Research Center also serves as the repository for the museum collections from Hovenweep and Yucca House national monuments. Park staff modified the Research Center to establish an appropriate collection storage space. These modifications were completed in 1982.

Mesa Verde National Park has several planning documents that have a direct bearing on the park's scope of collections. One of these plans, the Interpretive Prospectus (approved March 1981), identifies the following themes:

1. The evolution of prehistoric southwestern culture: the Mesa Verde Anasazi, their neighbors, antecedents, and descendants.

2. Early Euro-American explorers and settlers of the Mesa Verde.

3. Historic and modern Southwestern Native American art forms and their relationship to Anasazi material culture.

4. The natural history of the Four Corners area.

The park's approved Resource Management Plan (approved October 1983) states that the "park is divided into four land classification zones. Eighty-two percent of the park is represented in the Historical/Cultural zone. This is appropriate because of the large number of prehistoric sites and cliff dwellings found in the area and which caused the land to be set aside as a national park." It also states, "No less important than the ruins themselves are the materials they still contain and those which have been collected in the past during authorized archeological investigations." This collection, which numbers close to 1.5 million individual objects, has an immense research potential. "Much of it has not yet been properly studied, and even those portions which have been studied continue to yield new information as new procedures evolve in the analytical techniques of archeological research. Many individual items

from the collection are displayed in the park's archeological museum, but the vast majority are housed in the Research Center where they are available both for use in the interpretive displays and for scholarly research. While less obvious to the casual visitor, the prehistoric collection constitutes a major cultural resource."

Another portion of the Resource Management Plan states, "While the emphasis of the park is on cultural themes, specifically history and prehistory and to a lesser extent, ethnography, the natural history of the park has become a secondary theme, one which is essential not only to a full understanding of the park as a whole, but also to a better understanding of certain aspects of its history and prehistory. As a result, extensive collections in the natural sciences have been assembled since the creation of the park."

The park's approved Statement for Management (approved 1986) lists the following management objectives related to resource preservation:

1. To preserve, protect and interpret the park's cultural and natural resources.

2. To provide for visitor use, safety and enjoyment of Mesa Verde's cultural and natural resources.

3. To provide the opportunity for and encourage research by bona fide educational institutions and qualified individuals.

The approved Statement for Management also states that "the primary and most significant features of Mesa Verde National Park are archeological." It follows that the archeological part of the museum collection should be the most important. This is in fact the case, and Mesa Verde National Park manages one of the largest archeological collections in any national park. Archeological materials recovered from within the park are NPS property and must be cataloged into the museum collection in accordance with 43 CFR Part 7, NPS Management Policies (Dec 88), NPS-28, Cultural Resources Management Guideline.

36 CFR 2.5g states that specimen collection permits issued by the Superintendent must contain the following conditions: "(1) Specimens placed in displays or collections will bear official National Park Service museum labels and their catalog numbers will be registered in the National Park Service National Catalog; and (2) Specimens and data derived from consumed specimens must be made available to the public and reports and publications resulting from a research specimen collection permit shall be filed with the superintendent."

Other laws, regulations, and conventions, pertinent to museum collections at Mesa Verde National Park include: the Endangered Species Act of 1973, as amended (16 USC 1531-1543); the Bald Eagle Protection Act of 1940 (16 USC 668a); the Migratory Bird Treaty Act of 1918 (16 USC 703-711; the American Religious Freedom Act of 1978 (42 USC 1996); 43 CFR, Part 7;

36 CFR 2.5 (Revised 1984); NPS Special Directive 87-3, Conservation of Archeological Resources; the 1983 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and the 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property (implemented in the United States by P.L. 97-446 in 1983, 19 USC 2601).

II. TYPES OF COLLECTIONS

The interpretive themes, resource management goals and objectives, and mandates stated in the Introduction Section serve as guidance for acquiring objects for the park's museum collection. The park's museum collection is divided into two major categories: cultural collection and the natural history collection.

A. Cultural Collection

The purposes of this collection are to preserve a portion of our nation's cultural heritage and to increase knowledge and inspiration among present and future generations through exhibits, research, and interpretive programs. The cultural collection is sub-divided into three disciplines: archeology, ethnology, and history. The following list identifies by discipline object types appropriate to the park's museum collection and notes the current representation of these types of collections.

1. Archeology. Archeological collections are generated in response to cultural resource management requirements related to legal mandates, to development of park facilities, to preservation-related activities, to research requirements, and to interpretive needs. The archeological collection includes artifacts, human remains, and other materials obtained using archeological methods.

   Visitors and park staff are discouraged from picking up surface finds. Artifacts found on the surface by visitors should not be removed from their original location by the finder. They should be reported to park staff. If materials are turned in to park staff, appropriate measures must be taken to ensure that the visitor collects no more material, that precise provenience information is recorded, if possible, and that the objects/data are promptly turned in to the Mesa Verde Research Center upon receipt by staff members.

   The bulk of the museum collection consists of archeological material, which includes:

   a. Prehistoric Material. Mesa Verde National Park has historically been considered the type locality of the Mesa Verde Branch of the Anasazi culture. The materials excavated from archeological sites within the park have provided the

base-line data used to describe the material culture of these people, and it is an extremely important systematic research collection. The known prehistoric occupation of Mesa Verde National Park is about A.D. 500 through the 1200's. The Mesa Verde Anasazi did not "just appear", live in total isolation from their neighbors, nor "disappear". Therefore, examples of prehistoric material culture from archeological sites outside the park are included in the museum collection to adequately interpret and to better understand the cultural development of the Mesa Verde Anasazi. This material will continue to be collected on a limited basis. The objects must be relevant to the park's interpretive themes and be of scientific importance.

The park interprets the development of prehistoric culture from the Paleo-Indian culture through the Anasazi occupation of the Mesa Verde. Material culture remains from the Paleo-Indian, and Basketmaker II periods have not been recovered within Mesa Verde National Park. Therefore, the park has generally relied on loans of this material from other institutions to interpret these time periods through museum exhibits. The recent return of some of these objects to their owners has seriously disrupted exhibits in the Archeology Museum.

b. Historic Material. The collection contains historic material from sites related to the settlement of the lands within the park during the late 1800's, and associated with early park development, from 1906 through 1943. Materials from both Euro-American sites and Native American sites are included in this category. Only archeological materials dating to the historic period and directly related to the above are included in the museum collection.

c. Records. All records associated with archeological collections are retained as part of the museum collection. These records include field notes and catalogs, daily journals, drawings and maps, photographs and negatives, slides, sound recordings, raw data sheets, instrument charts, remote sensing materials, collection inventories, analytical study data, conservation treatment records, and computer documentation and data, as well as any other documents generated through archeological activity.

d. Confiscated Archeological Objects. These are objects recovered from unauthorized and illegal activities. They might include unearthed artifacts, ecofacts, and human remains illegally excavated or surface collected by unauthorized individuals within the park boundaries. The museum curator should be consulted as soon as possible to ensure proper handling and transportation of these materials. Such objects might be held temporarily as evidence if legal action is to be taken, but

should be formally turned over to the museum curator as soon as possible. The museum curator will maintain all such objects, following standard "chain of evidence" procedures, in the Mesa Verde Research Center. Once all legal questions are resolved, the objects and all associated documentation will be added to the museum collection.

2. Ethnology. The ethnology collection at Mesa Verde National Park contains approximately 1,200 objects. Acquired, mostly through gifts between 1920 and 1950, it presently includes examples of Native American material culture from the Southwest, the Great Basin, and adjacent culture areas. These artifacts illustrate the cultural continuity of the Native American cultures of the Southwest, as well as their cultural adaptation and change as seen through their material culture. They also illustrate Native American artistic traditions in the Southwest and provide examples of the arts and crafts of groups with whom Mesa Verde National Park has been associated.

   The collection consists primarily of Pueblo Indian ceramics, watercolors, and jewelry, and Navajo jewelry and textiles. There are also a few fine examples of Apache basketry, Pima basketry, and Ute beadwork. The majority of these objects are currently on exhibit, and the collection serves more of an interpretive function than a research function because of the limited number of types of objects represented.

   The park has important ties to the Ute tribe, but the collection of Ute material culture items is inadequate. Nearly all of the ethnographic artifacts on exhibit that are attributed to the Ute Indians are on loan to Mesa Verde National Park. The return of these objects to their owners would virtually eliminate this part of the park's interpretation. If interpretation of Ute culture is to continue, the park must collect additional examples of Ute material culture.

   While the park will continue to acquire ethnographic material from all Native American groups in the Southwest, emphasis will be placed on the material culture of those groups within the Anasazi geographic area.

3. History. Only historic material which has a direct association with the park is included in the museum collection. When a large quantity of an object is available, priority is given to acquiring the best preserved examples. The history collection is based on the park's themes used to establish the following collecting categories:

   a. Early Exploration and Homesteading (Pre-1906). There are few objects directly associated with the early exploration and homesteading of the Mesa Verde area in the collection, and it

is unlikely that much material of this type will become available. Known original field notes and photographs, such as those from the 1874 Hayden Survey, are now in the Smithsonian Institution. However, if original material of this nature becomes available, it should be collected.

b. Early Park Development, 1906-1932. Material in this category includes original correspondence between park staff and resource specialists (e.g., Dr. Jesse Walter Fewkes); photographs, blueprints, specifications and other items documenting facility development and resource preservation activities; building furnishings; and staff personal items (e.g., Superintendent Schumacher's badge, 1911-13). The park will continue to collect staff member's personal items that directly relate to park activities and documentary material, other than park administrative records, related to this time period that does not duplicate the material already in its possession.

   Park administrative records, including the superintendent's reports and chief naturalist's reports, are not part of the museum history collection, but are treated as an archival-type collection and maintained in the park library.

c. Civilian Conservation Corps (CCC, 1933-1942). The CCC period played an important role in the development of the park and in the preservation of park resources. Items in the museum collection from this period are: building furnishings, administrative records, construction drawings, photographic documentation of projects, tools, art work (e.g., P.W.A. artwork, exhibition illustrations), and architectural features. If more material documenting CCC activities becomes available, it should be collected when it does not duplicate what is presently available. Areas where documentation is incomplete include camp life, identification of personnel in the photographic records on hand, and copies of camp publications (e.g., Kiva Crier).

   Many of the park's administrative, maintenance, and residential buildings were either constructed or significantly modified during the CCC period, and are nominated to the National Register of Historic Places. Exceptions include mobile homes, the Research Center, modern buildings in the Far View area, and concessioner facilities in the campground. The museum collection should include representative samples of architectural fabric, documenting the original materials and workmanship of this period as it becomes available.

   Some works of art, created as exhibition illustrations, have been included in the museum collection. Other important examples remain in the exhibits and these, along with some

individual exhibits (e.g., dioramas) should become part of the museum collection. The exhibit cases themselves have also been included in the collection.

d. Current Events. Memorabilia from important current or commemorative events are included in the museum collection. Materials from the park's 75th anniversary and the First World Conference on Cultural Parks, for example, have been included. Materials from these types of activities will continue to be preserved as they become available.

e. Library Materials. A small number of library materials (e.g., rare books and manuscripts) are included in the museum collection at this time. The park library contains other rare books (e.g., Nordenskiold's 1891 publication) which should also be included in the museum collection. Rare books and original manuscripts, having direct association with Mesa Verde National Park, will continue to be included in the museum collection.

Mesa Verde National Park's library includes a large number of books that are out of print, technical references, and administrative documents. This material, though valuable, will not be included in the museum collection and will continue to be managed under the park's library management plan. The library and printed matter in the museum collection both support the park's research, interpretive, and resource management programs. In addition, the park library committee examines all current park files as they are purged to ensure retention of important materials in the park.

B. Natural History Collection

Collecting and maintaining a natural history collection, though of secondary importance to the cultural collection, is an important part of the management of the park's resources. The natural history collection exists to provide base-line data of park natural resources, to document changes these resources are undergoing because of internal park conditions and external effects, and to provide a data base for researchers concerned with resource use by the park's prehistoric occupants.

The means by which the natural resource museum collection should grow is through authorized scholarly research, which is based on needs identified in this document and in the park's approved Resource Management Plan. This scholarly research may be conducted by park or non-park scientists. Collecting by park staff must be in compliance with the park's approved "Staff Field Collecting Procedures." The collecting of research specimens by non-park scientists must comply with 36 CFR 2.5. All researchers must comply with applicable state and federal laws regulating collecting, documenting collections, and other associated activities.

Three separate areas of the park, totalling 8,100 acres, were designated as wilderness in 1976. Park Mesa received designation as a "Research Natural Area" in 1966. All collecting of natural resource specimens that impacts these areas must take into consideration restrictions in effect because of these special designations.

Natural resource specimens collected outside the park boundaries will not be included in the collection unless the specimens are required to illustrate interpretive exhibits, to augment specific park-related research projects or to demonstrate effects on park resources. Written permission from land owners or appropriate officials is obtained when collecting occurs on their land. This documentation must become part of the museum collection's accession file.

Taxidermy "mounts" and freeze dried specimens will be obtained only when a specific need (e.g., exhibit) is identified. Specialty collections such as frozen or other types of tissue samples are beyond the capability of the park to preserve. If such are collected and held by other repositories, they will be fully documented according to the applicable regulations. Archived soils and other strictly environmental monitoring samples will only be collected as part of authorized research projects.

This collection is divided into three disciplines: biology, geology, and paleontology. The following list identifies the categories of specimens which are to be included in the museum collection and notes their current representation.

1. <u>Biology</u>

   a. <u>Flora</u>. Each species of vascular plant growing in the park may be represented by a herbarium specimen, including fruit and flower, whenever possible. Additional specimens illustrating regional differences within the park as well as important variations in form, color, or hybrids, may also be included.

      Major herbarium collections of vascular plants were made in the 1940's and 1960's. Thus, nearly all species are represented in the herbarium. The non-vascular flora are not well represented in the herbarium. One research project has been conducted in this area; a lichen study was conducted in 1981. Specimens from this project are in the Mesa Verde herbarium. Duplicate specimens are at the University of Arizona.

      Three rare species of plants have been identified in Mesa Verde National Park. These are <u>Astraglus Schmollae</u>, C. L. Porter, <u>Astraglus deterior</u> (Barneby) Barneby, and <u>Hackelia gracilenta</u> (Johnston). Researchers must comply with all regulations governing these species.

b. Mammals. Each species of non-endangered mammal occurring in the park should be represented by one good study skin and skull of an adult male, and an adult female. Immature individuals may be represented when found to show significant differences from adults. The collection may also include the minimum number of specimens needed to illustrate the range of morphological differences present in the species, to show seasonal and transitional stages of pelage, and to record local varieties. Additionally, complete skeletal remains, casts of tracks of fore and hind feet, and scats may be collected. The majority of the mammal specimens in the collection were collected in the 1930's. Not all species found in the park are represented.

No known endangered, threatened, or rare species are known in the park.

c. Birds. Each species of non-endangered bird occurring in the park, either as a migrant or resident, should be represented by one good study skin and skull of an adult male, and an adult female. Immature individuals may be represented when found to show significant differences from adults. The collection may also include the minimum number of specimens needed to illustrate the range of morphological differences present in the species, to show seasonal and transitional stages of plumage observed in the park, and to record local varieties. Additionally, complete skeletal remains, one nest of each species, the minimum number of eggs required to show variation, and pellets may be collected.

The majority of the bird specimens presently in the collection were collected in the 1930's. Not all species found in the park are represented.

Two threatened, endangered, or rare species have been recorded in the park. These are: Haliaeetus leucocephalus and Falco peregrinus. Researchers must comply with all regulations governing these species.

d. Reptiles and Amphibians. Each species of non-endangered reptile and amphibian found in the park should be represented by one adult of each sex and a specimen of each distinctive developmental form. The collection may also include the minimum number of specimens needed to illustrate morphological differences found in the species or to demonstrate local variations.

Few species of reptiles and amphibians are currently represented in the museum collection.

No known threatened, endangered, or rare species are found in the park.

e. Fish. The Mancos River flows through the park on a portion of the eastern boundary, and the aquatic life found in this body of water in the park has not been studied to date. Each species of non-endangered fish found in the park may be represented by a limited series of specimens: One adult specimen of each sex, and the limited number of specimens required to document morphological differences within the species.

No endangered, threatened, or rare species are known in the park.

f. Insects and Arachnids. Each insect family occurring in the park should be illustrated by at least one adult specimen, but no more than will fill the smallest appropriate size of pinning tray. Insect larvae and soft bodied arachnids may be preserved in liquid. Species likely to arouse visitor interest because of their appearance, sound, bite, or sting should be represented by at least one properly mounted adult specimen, but by no more than will occupy the smallest appropriate size of pinning tray. Conspicuous larvae shall be included. Species of importance in park management (e.g., parasites and others potentially requiring control measures) should be similarly represented.

No known rare, threatened, or endangered species are found in the park.

g. Other Invertebrates. Invertebrates other than those referred to above, both aquatic and terrestrial, are not well documented in the park. A small collection of land snails was made in the 1930's. These species may be represented in the collection by the minimal number of specimens required to adequately document them.

h. Records, Data, and Reports. All records associated with specimens collected in conjunction with biological research must be maintained with the specimens as part of the museum collection.

i. Research Specimens (36 CFR 2.5). Specimens and associated field data and records generated as a result of approved research projects conducted by non-NPS staff are included in this category. The repository and responsibility for curation of any collections resulting from a research project are determined prior to the issuance of a permit.

2. Geology

   a. Rocks and Minerals. The minimum number of hand specimens, soil specimens, and mineral specimens required to document rock types, formations, soils and minerals found in the park should be collected. Additional specimens may be collected if needed to illustrate variations in structure or composition within the above units.

   b. Field Records, Data and Reports. All records associated with specimens collected in conjunction with geological research must be maintained with the specimens as part of the museum collection.

   c. Research Specimens (36 CFR 2.5). Specimens and associated field data and records generated as a result of approved research projects conducted by non-NPS staff are included in this category. The repository and responsibility for curation of any collections resulting from a research project are determined prior to the issuance of a permit.

3. Paleontology. Each species found in the park should be represented by the minimum number of specimens required to fully document the horizontal and stratigraphic range of the species and the various habitats in which each species was fossilized.

   Visitors and park staff are discouraged from picking up surface finds. Fossils found on the surface by visitors should not be removed from their original location by the finder. They should be reported to park staff. If materials are turned in to park staff, appropriate measures must be taken to ensure that the visitor collects no more material, that precise provenience information is recorded, if possible, and that the objects/data are promptly turned in to the Mesa Verde Research Center upon receipt by staff members.

   a. Invertebrate Fossils. The collection contains a representative and well-documented collection of invertebrates, mainly from the Mancos Shale Formation.

   b. Field Records, Data, and Reports. All records associated with specimens collected in conjunction with paleontological research must be maintained as part of the museum collection.

   c. Research Specimens (36 CFR 2.5). Specimens and associated field data and records generated as a result of approved research projects conducted by non-NPS staff are included in this category. The repository and responsibility for curation of any collections resulting from a research project are determined prior to the issuance of a permit.

III. ACQUISITION

The Park Superintendent, by delegation, represents the Secretary of the Interior in accepting title to and responsibility for museum objects. The Superintendent bears the ultimate responsibility for the acquisition and proper care and management of the museum collection. The Superintendent has delegated the day-to-day care of the collection to the park curator. Additions to the park's museum collection are made by field collection, gift, purchase, exchange, transfer, and loan. Consideration will be given to the realistic limits of park collection storage space and of park staffing before collecting authorized and acquisitions are accepted. Acquisition of museum objects is governed by the park's ability to manage and preserve them according to the NPS Management Policies (Dec 88), Chapter 5, and the standards for managing museum objects, in NPS-28, Cultural Resources Management Guideline, Chapter 3, Special Directive 80-1, and the NPS Museum Handbook, Part I. Museum objects are acquired, accessioned, cataloged, and inventoried in accordance with the procedures found in the NPS Museum Handbook, Part II, Museum Records. As required by NPS-44, Personal Property Management Guideline, Chapter 10, all proposals for the acquisition of firearms and ammunition, except archeological field finds, must be reviewed and approved by the Regional Curator.

The park will discourage gifts with limiting restrictions. In exceptional cases objects may be acquired accompanied by certain restrictions. These must be clearly stated on the Deed of Gift. Loans are not encouraged, and will be acquired only for a particular purpose (e.g., research or exhibition) and for a specified period of time.

Donors of prehistoric material must be able to demonstrate legal title to the materials and prove that they were not illegally removed from public lands. Gifts of prehistoric materials are not ordinarily accepted unless they have been collected in a scientific manner and have adequate provenience data associated with them.

Collecting, either under permit or by park staff, will be approved only in response to the park's need for on-site reference or to establish baseline data. The museum collection will not be a repository for cultural or natural science specimens in excess of these needs.

All permanent acquisitions must receive formal approval from the Park Superintendent or the Designated Receiving Officer before they can be accessioned into the museum collection. Upon receipt, all newly acquired objects and related documentation must be turned over to the park curator. The park curator prepares for the Superintendent's signature all instruments of conveyance, letters of thanks, acceptance, or rejection, and transmits these, as appropriate, to the donor, lender, vendor, or other source of acquisition.

IV. USES OF COLLECTIONS

The governing consideration in the use of museum collection objects is the preservation of each object and the collection as a whole. Researchers and other specialists may examine collections, but only in compliance with the preservation standards and procedures outlined in NPS-28, Cultural Resources Management Guideline and when following the written "Instructions for Using the Collections" established by this park.

Objects may be loaned out to qualified institutions for approved purposes. Institutions must meet minimal museum standards for security, handling, and exhibition of National Park Service museum objects. Sensitive materials may require additional conditions prior to a loan commitment. Expenses related to the loans of museum objects, including shipping and insurance, will normally be assumed by the borrower.

To fulfill the goals of the park as described in the introduction, the objects in the museum collection may be used for research, exhibits, and interpretive programs under the following conditions:

1. Objects will be available for scholarly research purposes that are consistent with the long-term preservation mandate for the collection and subject to the park's written "Guidelines for Access to the Museum Collection." Outside researchers must normally submit a research proposal to the Superintendent for review by the park's research committee before access to the collection is granted.

2. In accordance with NPS Management Policies (Dec 88), Chapter 7, page 5, the park will not exhibit disinterred skeletal or mummified human remains. Grave goods or other sacred objects will not be displayed if Native Americans who are cultural associated with them object to such display.

3. Museum objects will not be used consumptively or in interpretive demonstrations without prior authorization, following the specifications of NPS-6, Interpretation and Visitor Services Guideline.

4. Destructive analysis and tests must comply with the restrictions and procedures outlined in NPS-28.

5. Photographs of museum objects are made available on a limited basis to provide an indirect use of the park museum collection through publications and exhibits. Many of the park's archeological artifacts have been illustrated in publications.

6. All museum exhibits containing museum objects must have proper security and appropriate environmental controls to ensure the long-term preservation of the objects on exhibit.

V. RESTRICTIONS

Restrictions in addition to those applying to the use of the museum collection outlined in Section IV of this statement are as follows:

1. Mesa Verde National Park will not knowingly be a partner to or encourage in any way the trafficking in illicitly or unscientifically collected materials.

2. NPS <u>Management Policies</u>, (Dec 88), Chapter 5, state "Information regarding the location, nature, and character of archeological, historic, and ethnographic resources may be exempted from public disclosure."

3. NPS <u>Management Policies</u>, (Dec 88), Chapter 5, state "The identities of community consultants and information about sacred and other culturally sensitive places and practices will be kept confidential when research agreements or other circumstances warrant."

4. All endangered, threatened, or rare plants and animals will be collected only when accidentally killed or when dead from natural causes. Collecting threatened or endangered plant and animal species will be performed in compliance with NPS <u>Management Policies</u> (Dec 88) and in accordance with provisions of the Endangered Species Act of 1973, as amended. This activity will be strictly controlled and limited, based on the appropriate rules of the U.S. Fish and Wildlife Service and the National Park Service. Endangered, threatened, or rare species will never be killed in the park for the sole purpose of adding a specimen to the museum collection. Specimens of species meeting these criteria may be added to the collection if they are accidently killed or found dead of natural causes.

5. Restrictions may be placed on the publication of images or manuscripts in the museum collection if these are subject to copyright, and this right has not been signed over to the National Park Service.

6. The following specific restrictions are applicable to:

   Accession #231: The donor, Mr. S. L. Palmer, Jr., has stipulated that the records pertaining to this collection "remain as a unit" at Mesa Verde National Park.

   Accession #333: The donor, Ms. Mary Jane Colter, stipulates that the service must not refer to the objects included in her gift as a "collection."

   Accession #333: The donor, Ms. Mary Jane Colter, stipulates that the service must not refer to the objects included in her gift as a "collection."

Accession #322: Mesa Verde National Park originally received this accession from Carnegie Institution, Washington, D.C., as a loan. Items were subsequently donated to Mesa Verde National Park, to the Arizona State Museum (Tucson), and to the University of Colorado Museum (Boulder), with the stipulation that they remain on exhibit as a unit at Mesa Verde National Park. They are available, however, for special exhibits at these two other institutions.

VI. MANAGEMENT ACTIONS

This Scope of Collection Statement must be reviewed every two years, and when necessary, must be revised to remain supportive of and consistent with any changes in the park's mission. Any revision to this document requires the approval of the Regional Director.

The park has an approved Collection Management Plan. It was approved on June 22, 1988.

The park staff is compiling data on collections in other institutions which were removed from archeological sites within Mesa Verde National Park. Major collections were removed from the archeological sites presently within the park boundaries before its creation in 1906 and during the first two decades of the park's existence. The list of institutions in the United States which have important collections from Mesa Verde includes the Colorado Historical Society in Denver, Robert H. Lowie Museum of Anthropology in Berkeley, the Smithsonian Institution, and the University of Pennsylvania in Philadelphia. Part of the material removed from Mesa Verde prior to its establishment as a National Park has not remained in the United States. A notable collection made in 1891 by the Swedish scientist Gustav Nordenskiold is presently in the Finnish National Museum at Helsingfors, and in the Ethnografiska Museum in Stockholm. These collections still contain a wealth of information which has not been fully analyzed to date.

The continued use of cataloged historic furniture in public spaces is being evaluated in accordance with NPS guidelines.

Recall of loaned objects is a possibility. The park needs to secure ownership of exhibited objects on long-term loan in order to prevent potential disruption of permanent interpretive exhibits.

B. CHECKLIST FOR EVALUATING A SCOPE OF COLLECTION STATEMENT

This checklist can be used by park and regional staff to review a draft or approved Scope of Collection Statement (SOCS). Refer to NPS Museum Handbook, Part I, Chapter 2, Section B for guidance on writing a statement. Instructions for using this checklist are as follows:

1. Place a checkmark in the "YES" column to indicate that the required statement is in the SOCS, that the statement is correctly worded, and that it is in the appropriate section.

2. Place a checkmark in the "NO" column to indicate that the required statement does not appear in the SOCS.

3. Place an "X" in the "YES" column to indicate that there is a note explaining a partial deficiency either adjacent to the "X" response or in Section H of the checklist. Number each note included in Section H to correspond with the applicable checklist question.

4. Place an N/A entered between the "YES" and "NO" columns to indicate that the question is not applicable to the park's SOCS.

5. There may be times when the answer to a specific checklist question cannot be answered by the reviewer. If this is the case, print the phrase "Not Determined" on the appropriate lines.

NATIONAL PARK SERVICE
CHECKLIST FOR EVALUATING SCOPE OF COLLECTION STATEMENTS

Park: ______________________________

Draft ____ Approved ____ Date: ______________

Reviewed by: ______________________________ Date: ______________

	YES	NO
A. Does SOCS have TITLE PAGE?	____	____
1. Is Title Page format correct?	____	____
2. Does Title Page include all required signatures and dates?	____	____
B. Does SOCS have INTRODUCTION SECTION?	____	____
1. Is purpose of SOCS stated?	____	____
2. Is NPS legal mandate (5 basic laws) to acquire and preserve museum objects cited?	____	____
3. a. Is park's mission stated?	____	____
b. Is park's enabling legislation cited?	____	____
c. If applicable, is subsequent park legislation cited?	____	____
4. If applicable, is there a statement indicating that museum collection is mandated by park's enabling or subsequent legislation?	____	____
5. Park's Interpretive Themes:		
a. Are interpretive themes listed?	____	____
b. Are interpretive periods listed?	____	____
c. If available, are appropriate planning documents (title/date) cited?	____	____
6. Park's Resource Management Goals and Objectives:		
a. Are pertinent cultural and natural resource management goals and objectives listed?	____	____
b. If available, are appropriate planning documents (title/date) cited?	____	____
7. Mandated Systematic Collections:		
a. Is statement, citing 43 CFR 7.13 and NPS *Management Policies* (Dec 88), pp. 5:3-4, made that archeological collections are managed as part of the park's museum collection?	____	____
b. Is statement citing 36 CFR 2.5g made relevant to curatorial requirements for natural history specimens collected by approved permits?	____	____
8. Are other laws, regulations, conventions, and special directives relevant to acquisition of museum objects cited?	____	____
9. If applicable, are any special park designations (e.g., MAB Reserve, National Historic Landmark, World Heritage Site) that may be pertinent to museum collection cited?	____	____
C. Does SOCS have TYPES OF COLLECTIONS SECTION?	____	____
1. Is there an introductory statement indicating that Introduction Section states purpose of collection?	____	____
2. Is section divided into two major categories: Natural Resource Collection and Cultural Collection?	____	____

	YES	NO
3. Natural History Collections Category:		
a. If appropriate, is there a statement that park does not collect/maintain natural history collection for its own purposes?	____	____
b. If park collects/maintains a natural history collection is there an introductory paragraph that briefly outlines the purpose of this collection?	____	____
c. Is major category subdivided into disciplines (Biology, Geology, Paleontology) pertinent to park?	____	____
d. Is each discipline subdivided into collecting categories that reflect park's purpose for collection?	____	____
e. Are specific specimen types listed for each collecting category?	____	____
f. If appropriate, under each collecting category:		
1) Is current representation of object types noted?	____	____
2) Are priorities established to fill identified deficiencies (gaps) in existing collection?	____	____
3) Are limits (quantities) defined?	____	____
g. Are there collecting categories for "field records, data, and reports" and "collection permits" (36 CFR 2.5g) under each discipline?	____	____
h. Does paleontology discipline include statement relevant to "uncontrolled surface" collecting?	____	____
4. Cultural Collections Category:		
a. Does introductory paragraph include statement that describes the purpose of this collection?	____	____
b. Does introductory paragraph state that an object from site or directly associated to person(s) or event(s) commemorated by park is more desirable than a similar object without such primary association?	____	____
c. Is major category subdivided into disciplines pertinent to park (Archeology, Ethnology, History)?	____	____
d. Is each discipline subdivided into collecting categories that reflect park's purpose for collection?	____	____
e. Are specific object types listed for each collecting category?	____	____
f. If appropriate, under each collecting category:		
1) Is current representation of object types noted?	____	____
2) Are priorities established to fill identified deficiencies (gaps) in existing collection?	____	____
3) Are limits (quantities) defined?	____	____
g. Does archeology discipline include collecting categories for "artifacts and specimens" and "associated field records"?	____	____
h. Does archeology discipline include statement relevant to "uncontrolled surface" collecting?	____	____

	YES	NO
D. Does SOCS have <u>ACQUISITION SECTION</u>?	____	____
1. Is there a statement describing types of potential acquisition sources?	____	____
2. In accordance with NPS-44, Chapter 10, does section state that the acquisition of all firearms and ammunition, except those recovered from field collections, must be reviewed and approved by the regional curator?	____	____
3. Is there a statement regarding delegation to Park Superintendent to accept title to and responsibility for museum collections?	____	____
4. Does section state that museum objects must be acquired, accessioned, and cataloged in accordance with NPS <u>Museum Handbook</u>, Part II, Museum Records?	____	____
5. Is there a statement that discourages gifts with limiting conditions?	____	____
6. Does section include statement that acquisition of objects is governed by park's capability to preserve its museum collection in accordance with NPS <u>Management Policies</u> (Dec 88), <u>NPS-28</u>, <u>Special Directive 80-1</u>, and NPS <u>Museum Handbook</u>, Part I, Museum Collections (Rev. 1990)?	____	____
7. Does this section outline any park-specific acquisition procedures that supplement NPS policies?	____	____
E. Does SOCS have <u>USES OF COLLECTIONS SECTION</u>?	____	____
1. Is there a description of desired and acceptable uses?	____	____
2. In accordance with the NPS <u>Management Policies</u> (Dec 88), Chapter 7, page 5, "Interpretation and Native Americans" does section state that park shall not place skeletal or mummified human remains, grave goods or other objects considered sacred on display?	____	____
3. Is there a statement regarding conservation as a primary consideration when determining uses?	____	____
4. Is there a statement regarding access to museum collection?	____	____
5. Does section reference NPS-6 relevant to potentially consumptive uses of museum objects?	____	____
6. Does section reference NPS-28 relevant to research/ destructive analysis of museum objects?	____	____
F. Does SOCS have <u>RESTRICTIONS SECTION</u>?	____	____
1. Does section state NPS policy relevant to disclosure of information on location, nature, and character of archeological resources?	____	____
2. Does section state NPS policy relevant to community consultants may request that some information about religious materials be kept confidential?	____	____
3. If appropriate, is there a statement relevant to the collecting of endangered, threatened, or rare species?	____	____
4. Is there a statement regarding use of objects subject to copyright?	____	____
5. Does section identify any restrictions on disposition or uses of museum collection?	____	____

	YES	NO
G. Does SOCS have a <u>MANAGEMENT ACTIONS SECTION</u>?	____	____
1. Are there statements that require the following:		
a. Biennial review of SOCS?	____	____
b. SOCS remain supportive of and consistent with park's mission?	____	____
c. Regional Director's approval of any changes to SOCS?	____	____
2. Does section document existence of or need for Collection Management Plan?	____	____
3. If any collections are located outside the park's boundaries, is brief description of each collection and name and location of each repository identified?	____	____

H. <u>Comments/Recommendations</u> (If needed, attach additional pages.):

___See attached copy of park's ____ approved or ____ draft Scope of Collection Statement for editorial comments.

___Determine information needed to evaluate questions answered by the phrase "Not Determined."

___Revise the draft ____ approved ____ SOCS to correct the deficiencies noted in the checklist. Refer to NPS <u>Museum Handbook</u>, Part I, Chapter 2, Section B for guidance on writing a Scope of Collection Statement.

APPENDIX F. NPS MUSEUM COLLECTIONS MANAGEMENT CHECKLISTS

APPENDIX F. NPS MUSEUM COLLECTIONS MANAGEMENT CHECKLISTS

A. NPS INSPECTION CHECKLIST FOR MUSEUM STORAGE AND EXHIBIT SPACES

The revised NPS Special Directive 80-1 (March 1990), "Guidance for Meeting NPS Preservation and Protection Standards for Museum Collections" by reference includes the NPS "Inspection Checklist for Museum Storage and Exhibit Spaces." A copy of this checklist is included in this section.

Special Directive 80-1 requires that each park/center use the checklist to conduct a museum collections self-assessment in order to update progress of how well they are preserving and protecting the museum collections in their custody. Every three years parks are required to use this checklist to update data on deficiencies, costs for correction, and corrective actions taken relevant to museum collections preservation and protection. The data compiled from the completed checklists is used to update regional and Servicewide assessment of conditions, to more effectively distribute any funding allocated for correcting identified deficiencies, and to prepare periodic Internal Control Program Reports.

Use this checklist to inspect and evaluate the park's and center's storage and exhibit spaces. It is designed as a tool to help parks and centers evaluate how successfully they are preserving and protecting the museum collections in their custody. The basic requirements to meet NPS preservation and protection standards are listed in numerical order under the headings: museum collections storage, museum environment, security, fire protection, housekeeping, and museum planning. Page 2 of the checklist provides instructions for completing the self-assessment.

NOTE: The standards and requirements outlined in Special Directive 80-1 have been incorporated into Part I of the NPS Museum Handbook. However, Special Directive 80-1 remains in effect.

NATIONAL PARK SERVICE
Special Directive 80-1 (Revised 1990)

NPS INSPECTION CHECKLIST FOR MUSEUM STORAGE AND EXHIBIT SPACES

COVER SHEET

Park/Center Name: ______________________________

Organization Code: __________ Acronym: __________ Telephone No.: ____________________

Completed by: ______________________________ Date: ____________________
(Name and Title)

Reviewed/Approved by: ______________________________ Date: ____________________
(Superintendent/Center Manager)

NOTE: Parks may have two or more facilities (e.g., visitor center, room in historic structure, barn, park headquarters, maintenance shop) that house museum collections. Parks may also have two or more spaces that house museum objects within one facility (e.g., storage and exhibit).

In order to avoid having to complete a separate checklist for each facility or space, list each facility or separate space (e.g., storage or exhibit) in Table 1, "Park Facilities Housing Museum Collections." Use a separate line for each facility or space. Enter the appropriate function of the museum space: "E" for exhibit and "S" for storage. See example entry in table. Each facility with its designated space can then be referenced in the checklist by its "Facility Code" number. Each number is keyed to a facility and a specific museum space.

TABLE 1: PARK FACILITIES HOUSING MUSEUM COLLECTIONS

Facility Code	Name and Type of Facility	Museum Space
0	Sugarlands Visitor Center (Example Entry)	E, S
1		
2		
3		
4		
5		
6		
7		
8		

See the reverse side of this cover sheet for instructions on completing the attached checklist.
National Park Service

Instructions for Completing this Checklist

1. The attached checklist is designed as a tool to assist parks and centers in conducting a self-assessment on how successfully they are preserving and protecting the museum collections in their custody. Basic requirements to meet NPS preservation and protection standards are listed under the headings: museum collections storage, museum environment, security, fire protection, housekeeping, and museum collections planning. Use the checklist to inspect and evaluate the conditions in each storage and exhibit space in the park or center. Refer to Special Directive 80-1 (Revised 1990) for the standards and basic requirements to meet NPS preservation and protection standards for museum collections. PLEASE PRINT IN INK OR TYPE ALL RESPONSES.

2. Complete the information required on the top portion of the cover sheet. List the park facilities housing museum collections in Table 1 on the cover sheet of this checklist. Only one checklist needs to be completed regardless of the number of facilities.

3. Complete the infomation required on page 3 of the checklist.

4. Under each of the major headings of the checklist (e.g., museum collections storage, museum environment, security, fire protection, housekeeping, and museum collections planning) indicate on the line in parentheses the facility/facilities that apply to this heading by entering the corresponding facility code number recorded in the table on the cover sheet.

5. After each requirement, check YES or NO. A "NO" response indicates a deficiency at one or more facilities. In the "Deficiency" space use the appropriate facility code number to indicate the location of the deficiency. Then briefly describe the deficiency. If the requirement is not applicable, print "N/A" in the "NO" response space.

6. Under the "Corrective Action" Block, describe what action is to be taken to correct the deficiency. The action might be solved in one step (e.g., change the lock, purchase a storage cabinet) or it might be solved in more than one step (rehabilitate an existing storage space). If corrective action requires more than one step, describe the steps to be taken. For correction of deficiencies that require funding, it may be necessary to program funds. Include the step of programming for funds in this block.

7. Under the "Proposed Action Completion Date" Block enter the target date for correcting the deficiency. Entering two dates may be necessary: (1) Date that programming for funds has been completed; (2) Projected date for actual deficiency to be corrected, contingent on availability of funding.

8. Use page 24 of the checklist if additional space is required to describe deficiencies or corrective measures. Key additional information to checklist page number and item number (e.g., Page 4, Item 4 [Continued]:).

9. Complete Table 3 on page 27 of the checklist. If known, enter the estimated cost to correct identified deficiencies on each line. To determine costs, review programming documents (e.g., Forms 10-238 and 10-237), and budgets for new construction projects and repair/rehabilitation projects. Consult with the Regional Curator for assistance in determining costs. **Remember: Accurate estimates are important: Servicewide plans and long-range programming and budgeting are based on these data.**

10. Ensure that the Park Superintendent or Center Manager reviews, signs, and dates the checklist prior to submitting it to the Regional Office.

MUSEUM COLLECTIONS STORAGE

1. Are museum objects stored in a facility located within the park? YES___ NO___

   If the reply is "YES", continue to complete the checklist, including the Museum Collections Section, beginning on page 3.

   If the reply is "NO", do not complete the Museum Collections Section of the checklist. On page 3, print "N/A" on the "Facility Codes" line under the heading "Museum Collections Section."

2. Are park museum objects stored in an NPS or non-NPS repository located outside the park? YES___ NO___

   Note: NPS repositories include a storage facility located in another park and collection preservation centers. Non-NPS repositories include universities and museums.

   If the reply is "YES", complete Table 2. See sample entries in table.

TABLE 2: REPOSITORIES OUTSIDE PARK HOUSING PARK MUSEUM COLLECTIONS

Type of Collection	Name of Repository	Location of Respository
Archeological	WACC (Sample Entry)	Tucson, AZ
Archival	University of California (Sample Entry)	Davis, CA

MUSEUM COLLECTIONS STORAGE
(Facility Codes:_________________)

Dedicated Purpose:

1. The museum storage area is used solely for storage of museum objects. YES___ NO___

2. The curatorial office and research and work areas are separated from the museum storage space. YES___ NO___

3. Flammable liquids and materials, curatorial forms and supplies, and audiovisual equipment and other interpretive materials are stored outside the museum storage space. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

Physical Space:

4. The space is outside a floodplain. YES___ NO___

5. The space is in an area that will not flood if pipes break or drains back up. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

MUSEUM COLLECTIONS STORAGE (Continued)

6. The space is appropriately insulated to help maintain environmental conditions. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

7. If space has windows, they are blocked and insulated. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

8. Space has as few doors as possible to enhance security and environmental control, but has enough to meet requirements for employee safety. YES___ NO___

   Deficiency:

MUSEUM COLLECTIONS STORAGE (Continued)

Corrective Action:

Proposed Action Completion Date:

9. Space is as free of water, steam, drain, and fuel pipes as is practical. YES___ NO___

10. Space is free of water, gas, or electric meters, electrical panels, and utility valves that require monitoring and servicing by non-curatorial personnel. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

11. Space is sufficient for the movement of staff, equipment, and objects in and out without hindrances (e.g., inadequately sized doors; narrow, winding, or steep stairways; or low ceilings). YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

MUSEUM COLLECTIONS STORAGE (Continued)

12. Space is large enough to accommodate the current museum collection and the anticipated growth of the collection. YES___ NO___

13. Space is organized in a way that allows for easy access to museum objects and use of proper storage equipment. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

Methods and Techniques

14. Sufficient equipment (e.g., quantities, sizes, and appropriateness of cabinets, shelving units, specialized racks) is used to store and contain museum objects without crowding. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

MUSEUM COLLECTIONS STORAGE (Continued)

15. Museum cabinets are free of rust, have gaskets intact to provide good sealing action, have smoothly operating doors, and have working, keyed or combination lock mechanisms. YES___ NO___

16. Museum cabinet drawers are not loaded beyond 50 lb. capacity. YES___ NO___

17. Museum cabinets are not stacked more than two high. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

18. Open shelving is free of burrs, splinters, exposed nails, screws, bolts that can damage objects. YES___ NO___

19. Museum objects on shelving are not stacked upon each other. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

MUSEUM COLLECTIONS STORAGE (Continued)

20. Museum cabinets and shelving units are raised off the floor at least 2 inches if on casters or appliance rollers or at least 4 inches (preferable 6 inches) if stationary as a precaution against potential flooding and to facilitate cleaning of floors and inspection for pest problems. YES___ NO___

    Deficiency:

    Corrective Action:

    Proposed Action Completion Date:

21. Closed cell polyethylene foam is used in museum cabinet drawers and on shelving to cushion objects. YES___ NO___

22. Objects in museum cabinets are placed in specimen trays, padded or otherwise prevented from shifting when drawers are opened and closed. YES___ NO___

    Deficiency:

    Corrective Action:

    Proposed Action Completion Date:

MUSEUM ENVIRONMENT
(Facility Codes:__________________)

Temperature and Relative Humidity:

1. Levels of relative humidity and temperature in storage and exhibit spaces are monitored on a daily basis to provide an accurate and complete picture of all changes in both of these environmental factors during each year. YES___ NO___

2. A record of daily observations, noting occurrences such as unusual exterior climatic conditions, leaky roof, re-calibration of equipment, or an unusual visitation pattern, is maintained to help explain any variations in relative humidity and temperature readings. YES___ NO___

3. Records of relative humidity and temperature readings and of daily observations are permanently retained in the park's or center's curatorial files. YES___ NO___

4. Records of relative humidity and temperature readings and of daily observations are reviewed and analyzed monthly to determine relative humidity and temperature highs, lows, and means; and the frequency and extent of fluctuations. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

5. Working with the Regional Curator and other specialists, the park or center has established optimum relative humidity and temperature levels and acceptable highs and lows. YES___ NO___

   Deficiency:

MUSEUM ENVIRONMENT (Continued)

Corrective Action:

Proposed Action Completion Date:

Light:

6. The visible spectrum of light is monitored for illuminance level and duration, is controlled, and meets the standard in Special Special Directive 80-1 (Revised 1990). YES___ NO___

7. Levels of natural light (daylight) have been recorded quarterly for one year to establish seasonal variations. YES___ NO___

8. If park or center has a record of annual seasonal variations, a periodic spot check is made to ensure that levels do not exceed the upper limits for sensitive objects. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

9. UV radiation is controlled by a filtering material that has UV absorbing properties. The filtering material is periodically monitored to ensure its continued effectiveness. The level meets the standard in Special Directive 80-1 (Revised 1990). YES___ NO___

Deficiency:

MUSEUM ENVIRONMENT (Continued)

Corrective Action:

Proposed Action Completion Date:

<u>Pests</u>:

10. Monitoring (inspections) for evidence of insect, mold, and other pests infestations are conducted on an ongoing basis with especially close inspection of museum objects on a monthly basis. YES___ NO___

11. The control of pests is coordinated with the park's or center's Integrated Pest Management Program. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

<u>Dust</u>:

12. Dust covers are used on open shelving when objects are not otherwise protected from dust (e.g., in boxes). YES___ NO___

13. Dust in museum storage and exhibit spaces is controlled as part of the park's or center's housekeeping program. YES___ NO___

Deficiency:

MUSEUM ENVIRONMENT (Continued)

Corrective Action:

Proposed Action Completion Date:

SECURITY
(Facility Codes:_________________)

Key Control:

1. Keys to museum storage spaces and exhibit cases are issued to only those employees having direct responsibility for the collections. YES___ NO___

2. Issuing of keys to museum storage spaces and exhibit cases is strictly controlled by the use of a signed hand receipt (e.g., DI-105 or equivalent form). YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

Access Control:

3. Procedures have been written to control access to the museum collections by non-curatorial staff, outside researchers, and visitors. YES___ NO___

4. All researchers, visitors, and non-curatorial staff who enter the storage area are escorted at all times by park curatorial staff. YES___ NO___

5. A visitor/researcher sign-in log is used to record name and address of visitor, date of visit, time entered and time departed, and reason for visit. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

SECURITY (Continued)

6. Opening and closing procedures for museum spaces are written, approved and practiced. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

7. Museum objects in exhibit spaces are given additional protection at times of high risk, such as during times of crowding or of special activities. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

8. The special needs of museum collections are incorporated into the park's or center's Emergency Operation Plan. YES___ NO___

   Deficiency:

SECURITY (Continued)

Corrective Action:

Proposed Action Completion Date:

9. Entrances to museum spaces are equipped with metal or solid-core wood doors that have dead bolt locks. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

10. Intrusion alarm systems appropriate to the risks involved and to the nature of the museum collection are installed in museum storage and exhibit spaces. YES___ NO___

11. Installed intrusion alarm systems are inspected and maintained on a regular schedule to ensure that they are fully operational. YES___ NO___

    Deficiency:

    Corrective Action:

    Proposed Action Completion Date:

SECURITY (Continued)

12. Small, highly sensitive and valuable objects housed in museum storage spaces are kept in cabinets with keyed or combination locks. YES___ NO___

    Deficiency:

    Corrective Action:

    Proposed Action Completion Date:

13. Irreplaceable or particularly sensitive or valuable objects used in exhibits are protected in cases or by other means that provide protection from theft or vandalism, without making curatorial access impractical. YES___ NO___

    Deficiency:

    Corrective Action:

    Proposed Action Completion Date:

FIRE PROTECTION
(Facility Codes:_________________)

1. Fire detection and suppression systems appropriate to the risks involved, to the nature of the museum collection, and to the structure housing the collections are installed. YES___ NO___

2. Fire detection and suppression systems are inspected and maintained on a regular schedule to ensure that they are fully operational. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

3. An appropriate number and type of fire extinguishers are installed according to the anticipated types of fires, the nature of the collection, and the size of the protected area. YES___ NO___

4. Fire extinguishers are inspected annually to ensure that they are operational. YES___ NO___

5. Staff are trained in the use of fire extinguishers. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

FIRE PROTECTION (Continued)

6. Museum objects on top of shelving or museum cabinets do not obstruct the discharge heads for fire suppression systems and are not closer than 18" to the ceiling. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

7. Structures and spaces housing museum collections (e.g., walls, floors, ceilings, doors, windows, and other penetrations) are made fire-resistant to the extent possible, given the nature of the structure. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

8. All paper museum records are kept in a locking, insulated safe, file, or vault that will maintain an interior temperature of less than 350°F during a one-hour exposure to exterior temperatures of at least 1700°F. YES___ NO___

9. If the container described in statement #8 is housed on a level of a building above grade, the container also is rated to withstand a drop of 30 feet. YES___ NO___

FIRE PROTECTION (Continued)

Deficiency:

Corrective Action:

Proposed Action Completion Date:

10. Magnetic media (floppy disks and tapes) which back up NPS Automated National Catalog System (ANCS) data files are stored in a container (e.g., media safes, media files, mixed media files, and media boxes) that will maintain an interior temperature of not more than 125°F during a one hour exposure to an exterior temperature of 1700°F. (Note: Media boxes are acceptable only when inserted in an appropriately rated insulated records file.) YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

FIRE PROTECTION (Continued)

11. Flammable liquids and materials are housed outside museum storage spaces and, regardless of where stored, such materials are housed in approved flammables storage cabinets with proper ventilation. YES___ NO___

    Deficiency:

    Corrective Action:

    Proposed Action Completion Date:

12. The special needs of museum objects are incorporated in the park's or center's Structural Fire Plan. YES___ NO___

    Deficiency:

    Corrective Action:

    Proposed Action Completion Date:

HOUSEKEEPING
(Facility Codes:________________)

1. A housekeeping plan has been written for museum storage and exhibit spaces. YES___ NO___
2. Housekeeping in museum storage and exhibit spaces is performed according to the plan's established schedule. YES___ NO___
3. The housekeeping plan for museum spaces is reviewed annually and revised as is necessary. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

4. Smoking, drinking, and eating in museum storage and exhibit spaces are prohibited in writing. YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

HOUSEKEEPING (Continued)

5. Relative humidity and temperature monitoring equipment is calibrated quarterly. YES___ NO___

6. If a hygrothermograph is used to monitor relative humidity and temperature, it is regularly maintained (e.g., linkage is cleaned, ink is replenished). YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

MUSEUM COLLECTIONS PLANNING

1. The needs of the museum collection are adequately addressed in project statements that are included in the park's Resources Management Plan (RMP). YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

2. The park or center has an approved Collection Management Plan (CMP). (If the response is yes, indicate the approval date under corrective action.) YES___ NO___

   Deficiency:

   Corrective Action:

   Proposed Action Completion Date:

3. The park or center has an approved Collection Storage Plan (CSP). (If the response is "NO", and there is a special need for this plan, independent of a CMP, complete the information below. If there is no need for a Collection Storage Plan, print "N/A" in "NO" block.) YES___ NO___

   Deficiency:

MUSEUM COLLECTIONS PLANNING (Continued)

Corrective Action:

Proposed Action Completion Date:

4. Exhibit plans and historic furnishings reports are reviewed by park curatorial staff to ensure the proper use, preservation, protection, and maintenance of museum objects. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

5. Through a Collection Condition Survey, conservators have provided the park an assessment of the condition of objects on exhibit and in storage and have provided guidance on setting priorities for conservation treatment. YES___ NO___

Deficiency:

Corrective Action:

Proposed Action Completion Date:

Additional Comments (use additional pages if necessary):

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS CHECKLIST. YOUR EFFORTS HAVE MADE A SIGNIFICANT CONTRIBUTION TO THE PRESERVATION AND PROTECTION OF NATIONAL PARK SERVICE MUSEUM COLLECTIONS BOTH TODAY AND IN THE FUTURE.

TABLE 3. ESTIMATE OF TOTAL FUNDING NEEDED TO CORRECT DEFICIENCIES

Checklist Categories	Identified Deficiencies*	Costs
MUSEUM COLLECTIONS STORAGE		
Dedicated Space (1-3)		$
Physical Space (4-13)		$
Methods and Techniques (14-22)		$
MUSEUM ENVIRONMENT		
Relative Humidity/Temperature (1-5)		$
Light (6-9)		$
Pests (10-11)		$
Dust (12-13)		$
SECURITY (1-13)		$
FIRE PROTECTION (1-11)		$
HOUSEKEEPING (1-6)		$
MUSEUM COLLECTIONS PLANNING		
Collection Management Plan (2)		$
Collection Storage Plan (3)		$
Collection Condition Survey (5)		$
PARK'S/CENTER'S ESTIMATED TOTAL COST:		$

*NOTE: Enter in each block the number(s) corresponding to checklist item numbers that identify a deficiency requiring funds to correct.

B. NPS COLLECTION MANAGEMENT PLAN TEAM SITE VISIT CHECKLIST

The checklist contained in this section provides a detailed outline of the content of a Collection Management Plan. The broad categories of topics addressed in a Collection Management Plan are listed below.

•History of Park and Museum Collection
•Scope of Collection
•Museum Records
•Museum Security
•Museum Environment
•Museum Storage
•Museum Exhibits
•Housekeeping and Cyclic Maintenance
•Museum Staffing
•Planning, Programming, and Funding

Under each category the outline provides details of the types of topics that will be addressed by the team members. Each park and its museum collection is unique. The topics and depth of detail addressed in each park's CMP depends on the size, content, and condition of the museum collection.

The outline is provided to the park staff in advance of the CMP Team's visit to the park. It serves to orient the park Superintendent and staff on the types and depth of information that the team will require to prepare a plan that will be useful to the park. The checklist is used by the team members to ensure that each topic is adequately assessed and then covered in the plan.

NATIONAL PARK SERVICE
COLLECTION MANAGEMENT PLANNING SITE VISIT CHECKLIST

I. HISTORY OF PARK AND MUSEUM COLLECTION

Enabling Legislation/Authorization
Purpose of site/park
Cultural & natural significance of park
Provenance/source of collection
Size of collection
Types of objects in collection (disciplines and object classifications)
Visitation
- recent visitor statistics
- peak season/time
- visitor impact on collection

II. SCOPE OF COLLECTION

<u>Scope of Collection Statement</u> (Use NPS Checklist for Evaluating Scope of Collection Statements)
<u>Acquisition and Disposal</u>
Acquisition strategy
Gaps in collection
Priorities for collecting
Objects outside scope of collection
Deaccession proposal

III. MUSEUM RECORDS

<u>Records Storage & Preservation</u>
Fire-rated, insulated file cabinet with lock
Magnetic media safes, files, boxes
Location
- access/security
- load limitation

Archival photocopies of one-of-a-kind records
Archival quality materials
<u>Accession Records</u>
Accession Book
- first and last entries/dates
- consecutive entries and pages
- catalog numbers
- received from/how acquired
- multiple objects in single accession

Accession Folders
- proof of ownership
- correspondence on acquisition
- collection items or inappropriate papers/folders
- checklist
- Accession Receiving Report (Form 10-95)

Source of Accession file
Unaccessioned objects
- number & type

<u>Catalog Records</u>
Copies
- original copies
National Catalog submission
- blue "working copies" in green post binders
- classification & location files
- first & last catalog records (#/dates)
Registration & catalog data
- complete & accurate
- classifications correct
- descriptions sufficiently detailed
- condition indicated
- locations current (pencil)
- values current & updated periodically
ANCS
- percent of collection computerized
- type of equipment
Retrievability of objects and information
- objects marked with catalog numbers correctly
- acronyms used
Cataloging backlog
- number and type of objects
Catalog folders
- catalog worksheets
- object treatment requests and reports
- appraisals
- research information
- objects or fragments

<u>Inventory Records</u>
Type and date
100% inventory
- random inventory
- Forms 10-349, 10-349A, 10-349B, and 10-349C
- computerized
Controlled property
Missing objects
- Report of Survey (DI-103)

<u>Loan Records</u>
Incoming (number, location and renewal)
Outgoing (number, location and renewal)

<u>Photographs</u>
Object photos
- National Visual Inventory (Form 10-30)
Room/exhibit installation photos

<u>Other Records</u>
Primary documents photocopied on archival bond
Research files

IV. **MUSEUM SECURITY** (Use Survey Checklist)

Procedures
Physical and electronic security

Fire prevention, detection, and suppression
Emergency management

V. MUSEUM ENVIRONMENT

<u>Temperature and Relative Humidity</u>

Local Climate
- mean/extreme temperature and RH
- frost season
- annual precipitation

Measurements
- room-by-room
- outside
- past logs/charts

Equipment
- psychrometers (sling/aspirating)
- hygrothermographs
- dial thermohygrometers
- calibration frequency

Climate control
- HVAC system (type and location of air handlers, vents)
- portable humidifiers and dehumidifiers (location & number)

<u>Light</u>

Measurements (seasonal)
- ultraviolet
- visible

Light sources
- natural (doors, windows)
- artificial (fluorescent, incandescent)

Protection
- UV-filtering film on windows
- UV sleeves on fluorescent lights
- curtains, shades, shutters

<u>Dust & Air Pollution</u>

Local air pollution levels
- monitoring in park (by EPA or other agency)

Source of dust air pollution
- highways
- industry
- unexcavated basement

Air filtration/purification system
- HEPA filters
- activated charcoal filters
- portable air purifiers

Protective measures
- entrance mats
- weatherstripping

<u>Biological Infestation</u>

Past infestation
- pests identified
- action taken

- damage to collection

Evidence of current infestation (frass and droppings, tunnels and holes, nests)

IPM Program
- IPM Coordinator
- pest traps
- written log
- periodic inspections

Potential attraction and harborage sites
- kitchen (food storage)
- appliances
- plumbing/water source
- cracks and gaps
- trash removal (overnight)

Pesticides
- unauthorized use of PDB or dichloruos

VI. MUSEUM STORAGE

Existing Storage Condition

Location of museum storage
- attic
- basement
- water pipes/roof leaks
- available space (sq. ft.)
- additional space needed (compactor system, superinsulated building)
- load limitations
- space utilization (aisle widths, cabinet arrangement)

Dedicated storage
- non-museum storage
- restricted access

Exclusively curatorial functions
- percent of collection in storage
- type of museum objects
- organization of storage (by material or object type)
- size of objects stored

Storage equipment
- number of cabinets
- type of cabinets
- standard/double specimen cabinets
- wardrobe/jumbo GL-C cabinets
- visual storage cabinets
- entomology cabinets
- herbarium cabinets
- map cabinets
- security gun vaults
- art storage racks
- fire-insulated file cabinets
- steel shelving
- equipment needed
- condition of cabinet gaskets seals
- cabinet locks

Storage methods
- dustcovers
- elevated off floor
- polyethylene drawer liners/shelf pads
- ethafoam cavity packing
- museum objects stored on furniture
- stacking/crowding

Curatorial workspace
- separate from storage area
- examining table
- other equipment

Off-site storage
- leased space
- regional NPS repositories
- non-NPS repositories (documented loans)

<u>Condition of Objects in Storage</u>

Collection condition Survey needed

Storage materials
- inert, archival quality
- acid-free, buffered or unbuffered
- specimen trays
- padding

Periodic inspection for deterioration
- frequency
- evidence of deterioration
- conservation treatment needed

Condition of types of objects
- textiles (small--flat; large--rolled)
- costumes (flat or padded hangers)
- books (boxes, interleaving paper)
- unframed prints (print boxes)
- paintings & framed prints (racks)
- maps (flat in folders)
- manuscripts & archives (acid-free folders and document boxes)
- photographic prints & negative (photo envelopes)
- ceramics & glass
- furniture
- metals (iron, steel, copper, bronze, silver, pewter)
- firearms
- archeological artifacts
- wet specimens
- skins
- freeze-dried/taxidermy specimens
- herbarium
- wagons, carriages
- other____________________

VII. **MUSEUM EXHIBITS**

<u>Existing Exhibit Conditions</u>

Locations
- visitor center

- other exhibits with museum objects

Furnished historic structures
- approved furnishing report
- implementation of furnishing plan
- tour arrangements (average group size, guided/self-guided)
- placement of objects away from vents/light

Exhibit cases and construction
- UV glass
- inert materials
- curatorial access
- security (tamper-free)
- air tight (gasket seals)
- object mounts

Exhibit lighting
- low-voltage, cool lights

Exhibit maintenance manual

Rehab ilitation needed

<u>Condition of Objects on Exhibit</u>

Collection Condition Survey needed

Neutral barriers between objects of dissimilar materials (mylar, acid-free matboard

Evidence of deterioration
- conservation treatment needed
- weekly/daily inspections

Types of objects and exhibit techniques
- framed prints (acid-free mats/backs and UV glass)
- manuscripts & books (rotated/turned)
- textiles & costumes (refolded/rotated)
- wood furniture (waxed)
- silver (polished or lacquered)
- iron and steel (microcrystalline wax)
- natural history specimens
- other____________________

Reproductions
- cataloged
- substituted for fragile original

Objects accessible for visitors to touch
- NPS-6 consumptive use waived

VIII. HOUSEKEEPING AND CYCLIC MAINTENANCE

Existing Conditions
- museum storage
- exhibits
- dust
- clutter

Written housekeeping manual
- cleaning methods
- cleaning materials
- schedule

Equipment
- vacuums (backpack, portable)

- Endust-treated mops
- other equipment and supplies

Proper handling of museum objects
Cyclic preventive building maintenance
- Maintenance Management System (MNS)

Personnel
- maintenance staff (supervisor)
- curatorial staff
- training in curatorial housekeeping

Storage of cleaning supplies and equipment

IX. MUSEUM STAFFING

Curator (1015 series)
Museum Technician (1016 series)
Park Ranger with collateral duty
Supervisor/park division (Interpretation/Resource Management)
Museum Aid
Training and experience of incumbent
Training needs
- Curatorial Methods
- Critical Issues
- ANCS
- other____________________

VIPs and student interns

X. PLANNING, PROGRAMMING, AND FUNDING

Park planning documents include collections
- Statement for Management (SEM)
- General Management Plan (GMO)
- Outline of Planning Requirements (OPR)
- Resources Management Plan (RMP)
- Project Programming statements (Form 10-238)

Funding sources
- ONPS (base funding)
- Cultural Resources Management Funds
- Cultural Cyclic Maintenance Funds
- Cooperating associations
- other____________________

C. NPS CHECKLIST OF REFERENCE DOCUMENTS FOR COLLECTION MANAGEMENT PLAN TEAM

The checklist contained in this section provides a list of park related documents (e.g., legislation, park-specific plans, general park information, park museum operational procedures, curatorial budget, curatorial position descriptions and performance standards) that the team members will need to review and evaluate. Some of these documents (e.g., Scope of Collection Statement, Statement for Management, Interpretive Prospectus, Special Directive 80-1, NPS Checklist for Museum Storage and Exhibit Spaces, Annual Collection Management Reports) may be requested ahead of the team's site visit.

NATIONAL PARK SERVICE
CHECKLIST OF REFERENCE DOCUMENTS FOR COLLECTION MANAGEMENT PLAN TEAM

Legislation

______Enabling legislation, presidential proclamation, or executive order
______Subsequent legislation
______Congressional background reports
______Other:____

General Information

______Brochure(s)
______Handbook
______Other:____

General Park Plans

______General Management Plan
______Development Concept Plan
______Statement for Management
______Resources Management Plan (Cultural & Natural - including project statements related to collections and facilities housing them)
______Outline of Planning Requirements (Inventory of Park Requirements)
______Statement for Interpretation
______Interpretive Prospectus
______Park Administrative History

Plans and Documentation Specific to Museum Collections

______Scope of Collection Statement
______Exhibit Plan(s) (Including list of objects)
______Historic Furnishings Report(s)
______Collection Condition Survey(s)
______Collection Storage Plan
______Completed Special Directive 80-1 Checklist [update for current conditions]
______Annual Collection Management Report (Form 10-94)
______Collection Management Plan (park generated)
______Collection Management Checklist/Curatorial Operations Evaluation Report
______Annual Inventory of Museum Property

Other Pertinent Resource Management Plans

______Historic Resources Study
______Historic Structure Report(s)

______Historic Structure Preservation Guide(s)
______Ethnographic Plans
______Archeological Plans
______Other:____

Park Museum Collection Management Procedures

______Procedures for access and use of museum collection
______Opening and closing procedures for museum exhibit and storage spaces
______Housekeeping plans/schedules
______Park's Emergency Operation Plan (including Structural Fire, Physical Security, Disaster/Emergency Plans)
______Integrated Pest Management Plan
______Building/facility cyclical maintenance manuals/schedules

Other Park Procedures and Documents Relevant to Collection Management

______Construction drawings or blue prints for buildings housing museum collection (visitor centers, storage rooms, furnished historic structures, etc.)
______Basic Operating Plan
______Staffing/organization chart
______Position description(s) for staff assigned curatorial responsibilities
______Performance standards for staff assigned curatorial responsibilities and supervisor
______FY ____budget
______Cooperative agreements
______Requests for Base Increase Form 10-237
______Development/Study Package Proposal Form 10-238
______Operation/Field Area Evaluation
______Current permits for collecting natural history specimens (36 CFR 2.5g) expected to generate specimens for the museum collection

APPENDIX G. PROTECTION OF NATIONAL PARK SERVICE MUSEUM COLLECTIONS

APPENDIX G. PROTECTION OF NATIONAL PARK SERVICE MUSEUM COLLECTIONS

A. MANDATES AND REQUIREMENTS FOR SECURITY AND FIRE PROTECTION OF MUSEUM COLLECTIONS

1. Laws and Regulations

The National Park Service's security and crime prevention programs are based on various statutes requiring federal agencies to properly manage and protect their buildings and other property. The most pertinent statute is Title 40 of the United States Code, entitled "Public Buildings, Property, and Works." Paragraph 486(c) of Title 40 requires the head of each executive agency to issue such orders and directives as may be necessary to carry out the Government's property management regulations. This and other statutes have been translated into the Code of Federal Regulations. The most pertinent part of the Code is contained in Title 41 which is "Federal Property Management Regulations." Part 101, Subpart 20.5 is entitled "Physical Protection". It prescribes policies and methods for the physical protections of buildings and grounds operated by GSA and other Federal Executive agencies. The Department of the Interior's property management regulations are in Part 114 of CFR 41.

The Department of the Interior has supplemented CFR 41. Chapter 1 of Part 444 of the Departmental Manual "provides guidelines on that part of the Departmental security program related to measures designed to safeguard personnel; prevent unauthorized access to Federal real and personal property and records; and safeguard against espionage, sabotage, vandalism, and theft."

2. NPS Management Policies

Excerpts from the NPS Management Policies (Dec 88) relevant to security and fire protection are as follows:

Chapter 5 - Cultural Resource Management

SECURITY AND PROTECTIVE MEASURES (Page 5:13)

"The National Park Service will employ the most effective concepts, techniques, and equipment to protect cultural resources against theft, fire, vandalism, environmental impacts, and other threats without compromising their integrity or unduly limiting their appreciation by the public."

Fire Detection and Suppression (Page 5:13-14)

"Measures to protect cultural resources from fire will be developed as part of a park's fire management planning process, and prudent action will be taken to prevent harm to cultural resources by either fire or fire-suppression activities.

In the preservation of historic structures, every attempt will be made to comply with Servicewide standard building and fire codes. When these cannot be met without significantly impairing a structure's integrity and character, the management and use of the structure, rather than the structure itself, will be modified to minimize the potential hazards.

When warranted by the significance of a historic structure or of the museum objects in a nonhistoric structure, adequate fire detection, warning, and suppression systems will be installed. Fire-fighting personnel will be advised of any peculiarities or dangers inherent in a structure and any objects to be given priority for protection or rescue. Park personnel will receive training in fire prevention and suppression with hand-held extinguishers at historic structures and museums, and designated personnel will be trained to respond to all emergencies involving museum collections.

Smoking will not be permitted in spaces housing museum collections or in historic structures other than those adapted for modern residential and administrative uses."

Chapter 8 - Use of the Parks

Visitor Safety and Protection (Pages 8:15-16)

Visitor Safety

"...The National park Service will strive to identify recognizable threats to the safety and health of persons and to the protection of property, by applying nationally accepted codes, standards, engineering principles, and the requirements of the Loss Control Management Program Guideline (NPS-50)...."

Law Enforcement

"The National Park Service will make reasonable efforts to provide for the protection, safety, and security of park visitors, employees, concessioners and public and private property and to protect the natural and cultural resources entrusted to its care.

...Recognizing that effective enforcement requires a cooperative community effort, employees without law enforcement commissions will continue to share responsibility for the protection of park resources and visitors, and they will be expected to report any apparent violations or suspicious activities. Therefore, all park employees will be trained to recognize, observe, and record criminal acts and illegal activities..."

Chapter 9 - Park Facilities

Structural Fire Protection and Suppression (Page 9:7)

"Structural fires will be suppressed to prevent the loss of human life or to prevent damage to real property or cultural or natural resources. Fire suppression services will be provided primarily by appropriate community or county fire departments in accordance with the terms of agreements or contracting documents. At parks where such services are not available, the National Park Service will provide a level of structural fire protection commensurate with park needs.

Each superintendent will complete a structural fire needs assessment and develop and implement a structural fire plan, as appropriate, to meet park needs."

3. The revised Special Directive 80-1, "Guidance for Meeting NPS Preservation and Protection Standards for Museum Collections" (March 1990).

   This special directive requires that each park conduct a self-assessment of museum security and fire protection program using the NPS "Inspection Checklist for Museum Storage and Exhibit Spaces."

4. Additional NPS Guidance

   Additional NPS guidelines for security and fire protection are contained in the following references:

   NPS-9, Law Enforcement Policy and Guideline, Chapter 17.

   NPS-28, Cultural Resources Management Guideline, A Manager's Guide, Chapter 3, and Technical Supplement, Chapter 5.

   NPS-44, Personal Property Management Guideline, Chapter 10, Management of Firearms and Ammunition.

   NPS-58, Structural Fire Guideline, Chapters 5, 6, and 13.

   NPS Standards for the Design, Installation, Testing, and Maintenance of Interior Intrusion Detection/Alarm Systems (Revised Draft Manuscript, July 1984) by John Hunter, Midwest Regional Office.

   NPS Guide Specifications for Fire Alarm Systems (Revised Draft Manuscript, July 1984) by John Hunter, Midwest Regional Office.

5. NPS Requirements for Security and Fire Protection

   National Park Service policies and guidelines require parks to take certain specific actions to protect museum collections against theft and fire. The most important requirements are as follows:

a. Physical Security

- The park has identified all threats potentially affecting the museum collection and its museum and curatorial operations in general. Steps to counter those threats have been taken or are programmed.

- There are written procedures regarding access to museum collections, including storage rooms, curatorial work spaces, objects in exhibit cases, and objects in furnished historic rooms.

- Access to collections is limited to authorized NPS curatorial staff and volunteers and to others having direct responsibility for the collection on a recurring or emergency basis.

- Keys to storage rooms and exhibit cases are issued only to those employees who have a frequently (at least daily) recurring need for direct access to collections, either for curatorial work or for facility maintenance. Keys are not issued to personnel whose need for access is only occasional.

- The issuance of keys is strictly controlled by use of signed hand receipts, such as the Form DI-105 or its equivalent, and periodic inspections are made to ensure that all keys are properly accounted for.

- Whenever researchers or qualified visitors enter a museum collection storage area, they are accompanied at all times by someone on the park curatorial or protection staff.

- A log is used to record non-staff entries into museum storage areas; the log must record the visitor's name, address, date of visit, times of entry and departure, and reason for visit. For this purpose, GSA Form 139 or its equivalent may be used. The same or a similar log is used to record entries by NPS staff.

- Entrances to museum storage rooms are equipped with secure metal or solid-core wood doors in substantial frames; doors have deadbolt locks and other appropriate security hardware, such as non-removable pin hinges.

- Intrusion detection systems appropriate to the nature of the facility, the nature and value of the collection, and to known threats are installed and maintained. Proper response to alarms is ensured. Such systems receive regular preventive maintenance and are repaired promptly when they fail. High-value collections receive additional protection from electronic access control or closed-circuit television systems or from guards.

- Highly sensitive and valuable objects are housed in storage cabinets of an appropriate design with keyed or combination locks. Refer to NPS-44, Property Management Guidelines, Chapter 10, "Security of Firearms", for instructions on securing firearms and for information on gun vaults.

- Irreplaceable or particularly sensitive or valuable objects on exhibit are protected by cases or by other means that will protect them from theft or vandalism without making legitimate curatorial access or visitor viewing impractical or difficult.

- Museum objects on exhibit are given additional protection at times of high risk, such as during special events or when exhibit galleries are particularly crowded.

- Opening and closing procedure for museum exhibition, storage, and work spaces are written and always followed. Closing procedures include a thorough inspection of all areas of the facility for persons who may be hiding and for fire hazards. Opening procedures include a thorough inspection of all exhibits and storage areas to check for unauthorized entry during closed periods and to check for missing objects.

- A complete inventory is maintained of all museum objects. Written catalog records are supplemented by high quality black and white photographs of at least the more valuable or important objects in the collection. For additional information on documentary photography, refer to the NPS Museum Handbook, Part II, Museum Records.

- Exhibits or furnished rooms are opened to the public only when there are individuals present who perform a surveillance and security function. While it is most desirable and appropriate to have specialized protection personnel on site, in most cases it is acceptable to assign exhibit gallery security duties to properly trained non-security personnel, such as interpreters. It is not acceptable for security personnel to perform maintenance duties while trying to maintain surveillance.

- The park's Standard Operating Procedures include a section on employees, volunteers, and others who work in the museum or use its collections. Among those rules is a statement requiring all personnel to observe standards of ethics in their business and personal lives. Park staff are prohibited from collecting anything as a hobby that is collected by or is within the scope of the collection of the park without express written approval of the Superintendent.

- The park's museum protection program applies to everyone on the staff. No one is excluded from rules or safeguards due to rank, job function or position. The Superintendent and other

managers recognize the importance of their compliance with all established rules in a manner which reinforces compliance by their employees.

b. Fire Protection

- All museum property accountability and photographic records are kept in a locking fire-resistant filing cabinet, safe, or vault. Most parks will find that a filing cabinet, either letter size or legal size, is the most practical container for the records. If the container will be in a room on the ground level of the building, a UL approved Insulated Filing Device--Class 350 (formerly UL Class D) is acceptable. However, if the container will be in a room above ground level, a UL approved Insulated Record Container--Class 350 (formerly UL Class C) shall be used; this container is resistant to damage from dropping through a burning floor. In either case, the container should be lockable; a combination lock is recommended. For more information, refer to the NPS Museum Handbook, Part II, Museum Records.

  Spaces housing museum collections are protected by automatic fire detection systems appropriate to the risks involved, the nature of the collection, the nature of the fires that could occur in those spaces, and the capabilities and timeliness of responding forces. Detection systems are installed, maintained, and inspected in accordance with one or more applicable National Fire Protections Association (NFPA) standards. See Chapter 9, Section F for a list of those standards.

  Spaces housing collections are protected by the appropriate type(s) and number of properly located hand-held fire extinguishers or by a system of fire hoses and standpipes. Manual suppression capabilities have been selected according to the types of fires that are anticipated, the nature of the collection, and the size and nature of the protected area(s). Manual extinguishing systems are installed and maintained in accordance with National Fire Protection Association standards. See Chapter 9, Section F for a list of those standards.

  When appropriate and cost-effective, spaces housing collections are protected by automatic fire suppression systems. Installation, operation, and maintenance of these systems conforms to one of the applicable National Fire Protection Association standards. See Chapter 9, Section F for a list of those standards.

- All fire detection and suppression systems meet UL and NFPA standards and are tested and maintained regularly according to those standards and to the manufacturer's instructions.

- Park staff having responsibility for fire suppression are thoroughly trained in the use of available fire extinguishing equipment and in the operation of automatic systems, if any.

- When automatic suppression systems are installed, objects, shelves, and cabinets in museum storage rooms are placed so as not to obstruct discharge of the suppression agent. Potential damage to objects from agent discharge is minimized by ensuring that objects are in cabinets or under protective covers.

- There is a thorough and vigorously enforced fire prevention program in buildings housing collections and collection records. Smoking and open flames are not allowed in collection storage areas and are prohibited or strictly controlled in exhibit areas. Flammable solvents and supplies are not kept in collection storage areas. Flammable solvents and supplies are stored in UL approved flammable storage cabinets whenever it is necessary to have them in park buildings.

- Storage areas and, where possible, exhibit areas are of fire-resistant construction with a minimum of a one-hour fire spread rating on all six sides (wall, floor, and ceiling) and on all door assemblies. A two-hour rating or better is recommended, particularly for archival storage spaces. These requirements may not be possible in historic structures; when they cannot be achieved in such places, the absence of the minimum rating shall be compensated for by additional or higher quality fire detection and suppression systems.

- Emergency exit hardware is not employed on storage room doors except when deemed essential for safety of personnel. When used, emergency exit hardware does not compromise security without the application of compensating devices or systems, such as intrusion detection systems or exit alarms. The deadlocking of emergency exits is done in accordance with NFPA 101, The Life Safety Code, Part 5-2.1.5 "Locks, Latches, and Alarm Devices".

B. MANDATES AND REQUIREMENTS FOR EMERGENCY MANAGEMENT FOR MUSEUM COLLECTIONS

1. Laws

The subject of emergency preparedness is addressed in a number of Federal laws and regulations, although in every instance the focus is upon protection of visitors or upon broad, general issues of park management and resource protection. (Refer to the following U.S. Code Citations: USC 12 & 17; 16 USC 1a-6, 1b-1, and 3; 28 USC 1346 & 2672; and 31 USC 6483; also see 36 CFR 1.5.)

2. NPS Management Policies (Dec 88)

Specific excerpts from the NPS Management Policies (Dec 88) relevant to emergency management are as follows:

Chapter 5 - Cultural Resource Management

Emergency Management (Page 5:14)

"The emergency operations plan for each park with cultural resources will address their protection or rescue in the event of an emergency or disaster."

Chapter 8 - Use of the Parks

Emergency Preparedness and Emergency Operations (Page 8:6)

"The National Park Service will develop a program of emergency preparedness in accordance with the Federal Civil Defense Act (50 USC 2251 et seq.), National Security Decision Directive 259 (Feb. 4, 1987), departmental policy, and other considerations at the Washington, region, and park levels. The purpose of the program will be to maximize visitor and employee safety and the protection of property. This program will include a systematic method for alerting visitors to potential disasters and evacuation procedures.

Superintendents may assist other agencies with emergencies outside parks. To the extent practicable, written agreements with such other agencies in accordance with the Federal Assistance and Interagency Agreements Guideline (NPS-20) must first be in effect. NPS employees who are outside the area of their jurisdiction and who are directed by their supervisors to provide emergency assistance to other agencies will be considered to be acting within the scope of their employment.

NPS emergency operations will be conducted utilizing the Incident Command System (ICS) of the National Interagency Incident Management System (NIMS). Each park superintendent will develop and maintain an emergency operations plan to ensure an effective response to all types of emergencies that can be reasonably anticipated."

3. Additional NPS Guidance

Additional NPS guidelines for emergency management are contained in the following references:

NPS-50, Loss Control Management Guideline, Chapter 17.

NPS-28, Cultural Resources Management Guideline, A Manager's Guide, Chapter 3, pages 17 and 33, and Technical Supplement, Chapter 3, pages 12-18.

4. NPS Requirements for Emergency Management

- The park's Emergency Operations Plan identifies all disasters and other emergencies that could cause damage to or loss of the museum collection, in whole or in part. That plan either describes methods for protecting collections in time of emergency or refers to a separate museum emergency plan that describes such methods.

- The park has identified methods to mitigate against disaster related damage, to the extent possible, and has developed procedures for responding to and recovering from damages resulting from events that cannot be mitigated against. The park also has stockpiled emergency material for use during and after a disaster and has taken other appropriate preparedness measures in anticipation of emergencies.

- The park's emergency plan prioritizes museum objects as to their value and importance and establishes priorities for their protection and recovery when affected by disasters. Following the disaster, the most valuable or significant objects are given highest priority for emergency treatment.

- Secure on-site or off-site storage is available for protection of collections should regular storage or exhibit space be unusable following a disaster. Arrangements for the emergency use of non-NPS space, such as freezer plants, are kept current at all times.

- The park has cooperative or other agreements with local law enforcement, civil defence, and emergency response agencies, with other governmental and non-governmental agencies, and with nearby NPS units regarding mutual aid in time of disaster.

C. MUSEUM SECURITY SURVEY CHECKLIST

This section provides a general outline of the types of topics that _may_ be addressed in a detailed security survey of a park's museum spaces. A survey addresses elements of the park or facility perimeter security, the structure(s) housing the collection, procedural concerns, emergency action planning, and individual object protection.

1. _The Park or Facility_

    a. Name or identification
    b. Function or purpose
    c. Location
        1) Proximity to other facilities
        2) Proximity to communities
    d. Physical nature of the facility and its surroundings
    e. The climate
    f. Staffing
        1) Nature and size of staff
        2) Hours
        3) Seasonal variations
    g. Visitor access
        1) Visitor use characteristics
        2) Numbers of visitors
        3) Hours
        4) Seasonal variations
    h. The law enforcement situation
        1) Type of jurisdiction
        2) Reaction/response times

2. _Perimeter Security (External)_

    a. Fences, gates, natural barriers, and grounds
        1) Nature of fences and gates
        2) Gates (control, access, locks)
        3) Natural barriers
        4) Clear zones
        5) Underground passages
    b. Cover for possible illegal activity (e.g., vegetation)
    c. Lighting
        1) Nature
        2) Location and areas of coverage
        3) Maintenance and testing
        4) Power supply, circuit, and switching reliability
        5) Tamper resistance
        6) Operation
    d. Access control
    e. Patrols
        1) Nature
        2) Frequency
        3) Seasonal variations

f. Intrusion detection system
   1) Type of system
   2) Signal transmission mode
   3) Inspection, testing, and maintenance
   4) Power supply
   5) Tamper resistance
   6) Monitoring
   7) Records of alarm incidents

3. <u>The Structure Housing Museum Collections</u>

   a. Perimeter security
      1) Doors
      2) Windows
      3) Other openings
      4) Walls
      5) Roofs
      6) Floor, basement, and attic
   b. Interior security
      1) Connecting doors and pass-throughs
      2) Walls
      3) Ceilings
      4) Floors and crawl spaces
      5) Ductwork
      6) Storerooms, closets, utility rooms
      7) Vaults
      8) Storage cabinets
      9) Hiding places
   c. Locks and related hardware
   d. Lighting
      1) Security
      2) Emergency
      3) Lighting reliability
         a) Back-up power
         b) Secure switches
         c) Protected wiring
         d) Maintenance
   e. Intrusion detection system
      1) Nature and area of coverage
      2) Location of controls
      3) Tamper resistance of wiring and components
      4) Alarm transmission mode
      5) Maintenance and testing
      6) Back-up power
      7) Operating procedures and instructions
      8) Monitoring and documentation of alarm incidents
   f. Fire safety and control
      1) Detection systems
         a) Nature and area of coverage
         b) Location of controls
         c) Tamper resistance of wiring and components

d) Alarm transmission mode
e) Maintenance and testing
f) Back-up power
g) Operating procedures and instructions
2) Suppression mode(s)
3) Housekeeping
4) Evacuation
g. Safes

4. Procedures

a. Key control
b. Building opening and closing
c. Housekeeping practices
d. Employee control
1) Screening and investigation
2) Identification
3) Package and material control
e. Visitor control
1) Control of visitors to staff-only areas
2) Passes
3) Records of visits
4) ID's for contractors, tradesmen, utility workers
f. Visitor surveillance and inspection
g. Protection of administrative records
h. Security of cash and valuables
1) On site
2) In transit
i. Control of access to restricted areas or facilities
j. Property inventory and control
k. Security communications
1) Mode(s)
2) Reliability
3) Back-up power and alternate modes of communication
4) Employee operation
5) Efficiency and speed
l. Incident reporting
1) Timeliness
2) Accuracy

5. Emergency Operations Plan (EOP)

a. Does it deal with all possible contingencies?
1) Bomb threats and bombings
2) Civil disturbances (riots, war, breach of peace)
3) Natural catastrophes
4) Vandalism
5) Robbery and assault
6) Burglary
7) Fire
8) Equipment failure
9) Accidents with injury

b. Does it provide for notification of the right people in the right sequence?
c. Does it provide detailed reaction instructions or provide directions on how to obtain instructions?
d. Does it provide for reporting of emergency incidents to the Regional Office and to the proper local authorities?

6. <u>Individual Object Protection</u>

a. Storage spaces
   1) Physical construction
   2) Access control
      a) Physical
      b) Procedural
   3) Housekeeping practices
   4) Storage cabinets and shelves
   5) Inventory and material movement
   6) Alarms
b. Exhibit spaces
   1) Case construction
   2) Lighting of space and cases
   3) Surveillance by the staff
   4) Intrusion and tamper detection systems
   5) Inventory
c. Furnished rooms
   1) Access control
      a) Physical
      b) Procedural
   2) Intrusion detection systems
   3) Housekeeping practices
   4) Inventory

D. SOURCES OF ASSISTANCE

1. Organizations and Societies

The principal organizations and societies for museum security and fire protection are as follows:

a. The American Society for Industrial Security (ASIS)
1655 North Fort Meyer Drive
Suite 1200
Arlington, VA 22209
703/522-5800

The Society's Standing Committee on Museum, Library, and Archive Security has published a book "Suggested Guidelines in Museum Security." This publication provides guidance on physical security and fire protection in museums. The society also promotes and coordinates the annual National Conference on Museum Security.

b. The Museum Association Security Committee of the American Association of Museums (MASC)
c/o Smithsonian Institution
1111 North Capitol Street
Washington, D.C. 20560
703/357-1630

This committee is active in the printing and reprinting of publications on museum physical security and in promoting and coordinating the annual National Conference on Museum Security. In addition, the Committee publishes a newsletter.

c. The National Fire Protection Association (NFPA)
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9959
617/770-3000

This association, a voluntary membership organization, promotes and improves fire protection and prevention. Ths Association operates the Charles S. Morgan Technical Library that acts as a clearinghouse for relevant information on all aspects of fire prevention and management. It publishes numerous fire protection standards, as well as books and other educational materials on fire prevention, detection, and suppression. Write or phone the NFPA for a copy of its latest catalog. The Association's Technical Committee on Protection of Cultural Resources: Libraries, Museums, Places of Worship, and Historic Structures has developed for the NFPA standards applicable to archives, libraries, museums, and historic structures.

2. <u>Protection Staffs at Museums</u>

Some of the larger museums in the country have full-time staff who specialize in museum protection. Park curatorial staff, working with the park's law enforcement and fire protection staff, should consult with nearby museum protection staffs for technical assistance in security, fire protection, and emergency management.

3. <u>Law Enforcement Agenies and Fire Departments</u>

Parks located in or near urban areas should consult with the police department or fire department for technical assistance in the protection of museum collections.

E. SAMPLE PARK MUSEUM COLLECTION ACCESS PROCEDURES

Each park that has a museum collection is required to have a written set of access procedures. This section provides suggested format and language for comprehensive written procedures for access to a park's museum collection. The sample procedures are designed to cover all elements that need to be considered. Each park's written procedures should follow the sample's format; however, the language can be expected to vary considerably depending on each situation.

NATIONAL PARK SERVICE
SAMPLE PARK MUSEUM COLLECTION ACCESS PROCEDURES

PURPOSE

It is the policy of the National Park Service, and of (Name of Park), that its natural and cultural resources shall be made available for educational and scholarly purposes. The primary value of the park's museum collection is as a resource of this park; with that value in mind, the park staff is charged with the collection's preservation. However, the collection also possesses considerable research value and its use for research is always encouraged. The National Park Service is mandated to protect its resources at the same time that those resources are made accessible to the public. With that mandate in mind, the staff also is charged with regulating access to the park's collections. This document serves as a guide to the staff in carrying out its responsibilities for both encouraging and regulating access to the collections and for meeting the needs of prospective researchers.

GENERAL ACCESS PROCEDURES

1. Except as otherwise may be noted below, this written procedural statement applies equally to museum objects, archival materials, and museum collection records. These procedures also apply to information about such park resources written by the staff in the course of their official duties.

2. Access to objects in the collection, to storage cabinets and exhibit cases, and to keys to locks on storage rooms, storage cabinets, and exhibit cases will be strictly controlled by the Superintendent and/or the Chief Ranger. All areas thus controlled shall be identified as "Secure Areas".

3. Only those persons identified under "Eligibility for Access to Museum Collections" will be permitted access to secure areas under ordinary conditions. Under emergency conditions, emergency response personnel may have access to secure areas, but only under such conditions and with such supervision and control as the Superintendent may establish in the park's Emergency Operations Plan.

4. The granting of access to a secure area does not automatically grant access to objects, archival materials, or records kept in those areas. Only persons with legitimate needs to use, study, photograph, or handle collection items will be granted access to them; other persons may be granted access only to rooms housing such items. A request for access must indicate whether the request applies only to a secure area or to both the area and the collections therein.

5. The Superintendent will designate, in writing, those park personnel whose positions or duties dictate that they should have access to secure areas or to the collections without their being accompanied by other staff. Normally, only curatorial staff, whether full time or collateral duty, will receive such a designation. Persons <u>not</u> so designated MUST be

accompanied by one of the designated personnel in order to gain legitimate access to the collections. Persons holding a designation from the Superintendent are referred to as "authorized staff" in this policy statement.

6. All persons, except authorized staff, who request access to collections for the purposes of using or viewing objects, archival materials, or collections records must specify in their request which items or groups of items they will want to use. If permission to access the collections is granted, only those items will be made available. Persons already working with collections may verbally request access to additional items; their requests will be considered on a case-by-case basis.

7. This procedural statement should be reviewed every two years and revised as necessary for it to remain current and viable. Review concurrently with review of the park's approved Scope of Collection Statement.

ELIGIBILITY FOR ACCESS TO MUSEUM COLLECTIONS

Access to the collections should be granted by the Superintendent or the Chief Ranger to the following persons or classes of persons:

1. **Bonafide researchers**. A person may be considered "bonafide" by: (a) presenting documentation that he/she is affiliated with a recognized educational institution, either as faculty or as a registered student, or that he/she is on the staff of a recognized museum; (b) demonstrating, preferably in writing, that he/she needs to study objects or records in the park's collections in order to conduct research; (c) demonstrating that the research to be conducted has merit, i.e., that it is not frivolous and that the results of the research will benefit either the researcher's institution or the park (or ideally both); and (d) that those results will be made available to the park in some form. All persons granted access under this item of eligibility must be accompanied at all times by authorized park staff.

2. **National Park Service staff from the Regional Office, the Washington Office, either of the design centers, or other parks who are visiting the park on official business**. The nature of their work must require them to evaluate, inspect, or work with the collections or the rooms, cabinets, or cases housing the collections or with park records on the collections. Persons granted access under this category of eligibility do not necessarily have to be accompanied by park staff at all times; a decision in that respect will be based on their reasons for needing access and on other factors that the Superintendent may consider germane at the time.

3. **Members of Native American groups having official business with the park staff, for examining, handling, or appraising archeological or ethnographic objects in the collections**. The Superintendent should ascertain that the individuals are tribal members, and not individuals who may or may not otherwise be eligible to request access on their own right

(see below). Normally, when persons from a certain tribe are allowed access to the collections to use objects representing that tribe, they will not be allowed access to objects representing other tribes. Exceptions may be made on a case by case basis as necessary. All persons granted access under this item of eligibility must be accompanied at all times by park staff.

4. **Non-curatorial park employees, including volunteers, who are being oriented to the park and their work or who require access to collections as part of their internal training.** Such persons must be accompanied at all times by authorized park staff.

5. **Park maintenance and protection staff in the performance of their official duties.** Except in the most unusual circumstances, such personnel shall have access only to rooms in which collections are kept, not to storage cabinets or exhibit cases or to key boxes or other places where keys to cabinets and cases are secured. As provided below, other means shall be made available to these personnel for emergency access. Persons granted access under this item of eligibility do not necessarily have to be accompanied by curatorial staff, but should be whenever possible.

Access to the collections by the following persons or classes of persons is discretionary but may be granted by the Superintendent or the Chief Ranger:

6. **Private individuals seeking to use the collection for research or study.** Such persons must present credentials satisfactory to the Superintendent that they have serious intent and are engaged in research which necessitates examination of objects or records at close hand. The Superintendent may require the presentation of a written research proposal or other documentation of the type that would be presented by someone affiliated with an educational institution or museum (see number 1 above). Persons granted access under this item of eligibility must be accompanied at all times by park staff.

7. **Individuals or representatives of organizations, institutions, or corporations desiring to use objects or records in the collection for commercial or publicity purposes.** Such persons must satisfy the Superintendent that their purposes are legitimate and that the proposed uses are in keeping with park purposes and the NPS mission and will not reflect adversely on the park, the National Park Service, or a Native American tribe, if the request is for tribal materials. In addition, such persons must satisfy the Superintendent that their purposes cannot be met by access to collections or institutions outside the park. Access should not be granted solely on the grounds that access to the park's collection would be more economical or "easier" for them than access to another collection. Persons granted access under this item of eligibility must be accompanied at all times by authorized staff.

8. **Employees of construction or service companies who require access to collection storage or exhibit areas in order to service or maintain the building or its utilities, including alarm systems.** Such persons will be

allowed access only under the terms of a contract or purchase order issued by or for the park and only to those areas where they are supposed to work. Under no circumstances shall such persons be allowed unsupervised access to objects kept in storage cabinets and exhibit cases. Except as may be otherwise provided in the language of the contract or purchase order, all persons granted access under this item of eligibility must be accompanied at all times by authorized staff. The Superintendent or the Chief Ranger shall have the authority to restrict access otherwise granted by this paragraph, under such circumstances where it is deemed advisable.

9. **Other persons or groups of persons may be allowed limited access to the collections, on determination by the Superintendent or the Chief Ranger that such access will be to the mutual benefit of the persons or groups and the park.** Examples of circumstances to which this item of eligibility might apply include: tours for school classes, tours for members of museum organizations or historical societies, tours for families of park employees, orientation for local political/governmental officials, orientation for visiting Park Service employees not on official business, and tours for non-NPS museum personnel, teachers, and prospective researchers who are considering applying for permission to use or view the collection. All persons granted access under this item of eligibility must be accompanied at all times by park curatorial staff.

In applying the above items of eligibility, persons under 16 years of age generally should not be admitted to collection storage areas. That provision may be waived by the Superintendent or the Chief Ranger in respect to family members of park employees or when circumstances dictate that it may be waived without endangering collections. Authorized staff may allow access to members of their immediate families under 16 years of age without further permission; the staff person must accompany his/her family member(s) and will be held responsible for their conduct.

All organized groups of school-age children must be under the direct control of at least one adult (teacher or parent) for every 10 children on the tour. To comply with this policy, it may be necessary to allow only limited numbers of students into a secure area at one time. This policy does not apply to groups in exhibit areas open to the general public during regular visiting hours. This policy does apply to such groups outside of regular visiting hours, even in otherwise publicly accessible exhibit areas.

CONDITIONS OF ACCESS

The following conditions apply equally to all non-staff persons granted access to a secure area, unless so indicated to the contrary.

1. Access to a secure area will be allowed only during regular park operating hours, unless other arrangements have been made in advance of the visit.

2. The staff is obliged to consider requests for access only when requests are made in advance of the day of visit. Therefore, persons needing to

have access are urged to make their requests known to the Superintendent or the Chief Ranger as far in advance as possible.

3. Prospective visitors should be aware that the park staff is extremely busy at certain times of the year and that authorized staff may not be available to assist them at those times. Accordingly, it is suggested that persons needing access offer or be prepared to discuss alternative times with the staff when they submit their requests.

4. The park's decision to allow access may depend upon the availability of space for the requester to work. The park attempts to keep at least some space available at all times for visiting researchers. However, if one researcher already has been accommodated, there might not be space for others at the same time. Space availability also might be affected by in-house activities, such as inventorying collections, cleaning exhibits, and staff research activities.

5. All guidelines for handling artifacts and archival materials <u>must</u> be followed by <u>all</u> collection users, whether staff or non-staff. Those guidelines are published separately and may be requested in advance of a visit. A copy of the guidelines also will be provided to each user at the time he/she arrives.

6. <u>All</u> persons, staff and non-staff alike, must sign in and out of collection storage area on the "Collections Access Log". A sample page from the log is attached to these procedures. A log book will be found outside the door to each storage area.

7. All non-staff visitors and all staff visitors who are not designated as "authorized staff" <u>must</u> be accompanied at all times by authorized staff when in museum collection storage areas or when working in open exhibits. Exceptions to this rule may be made at the discretion of the Superintendent or the Chief Ranger. When authorized staff are not required to accompany a visitor, they still will be available to render assistance.

8. The park reserves the right to require a third-party recommendation for any individual desiring access to the collection who is not already known to the staff.

9. The park reserves the right to receive the following as a condition for granting access to the collections:

    a. Copies of any notes, measured drawings, or photographs taken on or of objects or records in the collections.

    b. Copies of completed research papers and publications deriving from work on the collections.

    c. Copies of completed research papers and publications when they contain photographs of objects in the collections or facsimile copies of documents in the archival collections.

d. Copies of any reports or publications based solely or largely on research conducted on the collections.

Copies of formal reports and other published materials shall be provided at the researcher's expense. Copies of notes, drawings, photographs, and other products of research shall be provided at the researcher's expense, except when doing so constitute an economic burden, in which case the Superintendent can elect to defray those costs or waive the requirement for the researcher to provide the materials.

Because the physical integrity and safety of the collections are a primary park responsibility, no one will be granted unlimited, totally discretionary access to the collections except for the Superintendent and the Chief Ranger and such other permanent staff that they may designate in writing to have that privilege. Anyone's access can be denied or restricted by the Superintendent at any time and for any reason. Any unforeseen questions or problems regarding access will be considered by the Superintendent on a case-by-case basis.

Under no circumstances, excepting emergencies, will persons other than authorized staff possess, carry, use, or otherwise have access to keys to locks on storage rooms, storage cabinets, exhibit cases, and other places where museum objects, archival materials, or museum collection records are kept. This rule also applies to combinations of locks on safes and vaults.

F. SAMPLE PARK MUSEUM OPENING AND CLOSING PROCEDURES

Parks are required to include museum collection concerns in their written opening and closing procedures for each facility that houses museum objects in storage and on exhibit. The sample opening and closing procedures included in this section is based on an actual memorandum issued by an NPS historic site.

The name of the park and its historic house have been replaced with dashes to preserve site security. The names of all buildings and locations within the park and of some spaces within buildings have been replaced with dashes as well. In most instances, words appear within the dashes to make clear the function of the word that was deleted. Each park's written procedures should follow the sample's format; however, the language can be expected to vary considerably depending on each situation.

NATIONAL PARK SERVICE
SAMPLE HISTORIC HOUSE OPENING AND CLOSING PROCEDURES

FILE CODE

SUPERINTENDENT'S DIRECTIVE NO. XXX

To: All --PARK NAME-- Personnel

From: Superintendent

Subject: --HOUSE-- Opening and Closing Procedures

Purpose: To establish responsibilities for security and daily opening and closing procedures of --HOUSE--.

Policy: Park personnel assigned to --HOUSE-- will follow established guidelines to ensure proper security of the site and protection of the resource.

Guidelines:

The intrusion detection system at --HOUSE-- will be activated during all non-business hours. Generally this is from 4:30 PM to 7:30 AM daily. (Hours may vary slightly on weekends.)

On days when --HOUSE-- is not open to the public, the Curator is responsible for arming the intrusion detection system at the end of the workday. On days when the house is open to the public, it is the responsibility of the interpretive staff to arm the system. Generally the house is open on weekends and Wednesdays through Sundays during the summer.

Each morning, it is the responsibility of the Park Guard staff to disarm the intrusion detection system. The guards on duty will turn off the systems during the early morning patrol at about --TIME--.

It is the responsibility of the --HOUSE-- Curator and --HOUSE-- custodian to maintain security on days when the house is not open to the public. Exterior doors should remain locked at all times and the house should be secured and alarmed at the end of each workday.

It is the responsibility of the Interpretive staff to secure --HOUSE-- on weekends and on other days that the house is open to the public. The closing procedures should include inspecting the entire house, not just the areas used by the public.

The evening guard patrol of --HOUSE-- will include an inspection to ensure that the house has been properly secured. Before entering --HOUSE--, the park guard will patrol around the exterior of the house shining the flashlight on each of the windows to ensure that they are closed. Only if all appears secure, will the guard enter the house alone to complete the inspection.

Closing Procedures:

The following steps are taken by designated Interpretive or Curatorial staff. As you walk through the house, note maintenance or safety concerns or questions about artifact security.

1. Ensure that visitors are out of the house. Record tour and visitation statistics (when the house has been open to the public).

2. Place the moveable "entrance" signs inside the Conservatory (when the house has been open to the public).

3. Lock all exterior doors. Exterior doors are located in:
   - Conservatory (2 doors)
   - Front entrance
   - Atrium or Small Conservatory
   - Den
   - Kitchen Pantry Hall
   - Servants' Hallway

4. Close all windows and fasten those that can be locked. Check windows in the Conservatory and on all three floors of the house.

5. Pull down the window shades as you check each window.

6. Put the two tripods with fire detectors in their proper position in the Foyer and the Dining Room. Poles should be extended so the detector heads are as close to the ceiling as possible.

7. The following interior doors MUST be closed:
   - Front double doors (dead-bolted top & bottom & chained)
   - Basement electrical room
   - First floor Servants' Hall door to Basement
   - Second floor hall door between Servants' Wing and Staircase (Intrusion alarm does not arm properly if they are open.)
   - Basement Furnace Room
   - Third floor door to Attic stairs (Doors must be closed in these Halon protected areas to ensure adequate suppression in case of fire.)

8. The following interior doors SHOULD be closed if possible:
   - All basement room doors except fire control panel room
   - All doors to --ROOM--
   - Both doors to China Storage area
   - Servants' Hall door to Front Foyer (Closing these doors reduces chances for false alarms.)

9. Leave night lights on in the following areas:
   - Laundry Room, above the sinks
   - Kitchen, above the sink
   - Servants' Hall, above the radiator
   - Dining Room, one light on each of the two sconces
   - Entrance Hall, inner chandelier globe. (Switch is in closet)
   - Second floor Servants' Hall staircase

10. Activate the two intrusion detection system panels in the Laundry Room. Remember the Servants' Wing exit must be closed before the system is armed. Exit the house through the Servants' Wing door.

11. Make a final patrol around the outside of the house to check doors and windows. Do not jiggle doors or windows from the outside. Doing so might cause an intrusion alarm.

<u>Opening Procedures:</u>

Intrusion detection systems at --HOUSE-- are disarmed each morning by either the park guard or by another designated member of the Division of Visitor Services. The systems will be off prior to the time that other park staff need to enter the house.

1. Before entering --HOUSE--, walk around the outside of the house and check for signs of entry. If anything looks suspicious do not enter; report the observation to the protection staff immediately.

2. Enter --HOUSE-- through the Servants' Wing door and then lock the door behind you.

3. Check the status lamps and alarms on both alarm system panels in the Laundry Room and report any malfunctions.

4. Make a walk-through visual inspection of the entire house, including the basement and upper floors. Make particular note of signs of attempted entry, safety or maintenance needs, and the location of artifacts. Report concerns or problems to the appropriate protection or curatorial staff.

5. When the house is open to the public, take down the two portable fire detectors in the Foyer and Dining Room. Place them in the Hall Closet.

6. If the house is to be open to visitors, prepare the rooms along the tour route by opening shades and turning on the appropriate lights. Make a special note of safety and security concerns in these visitor use areas.

7. Prepare for greeting visitors by placing the entrance signs outside. Establish tour assignments, prepare the visitor statistic sheet and ensure that a supply of folders is available.

8. In summer, when temperatures are hot, visitors will enter through the front door. When weather is cool, the Conservatory will be opened as a waiting area for visitors. If the Conservatory is to be opened, clean up the room, place literature out on display, and unlock both exit doors from the room.

9. Call the --MAIN SITE-- visitor center desk to let them know --HOUSE-- is ready for visitors and to check for any special tours or activities.

10. Throughout the day, be certain that all doors into --HOUSE-- are locked unless you can observe them. Generally, the only doors that should be unlocked during the day are those in the Conservatory when it is being used as a visitor waiting area.

Superintendent

APPENDIX H. CURATORIAL HEALTH AND SAFETY

APPENDIX H. CURATORIAL HEALTH AND SAFETY

A. LAWS, REGULATIONS, AND NPS POLICIES AND GUIDELINES

Special Directive 83-7 (Revised 1984), National Park Service Safety and Occupational Health Management Policy, states "it is the policy of the National Park Service to provide and maintain a safe healthful work environment." The NPS Occupational Safety and Health Program has been developed around the concepts of loss control management. This program is based on the following authorities and guidelines:

- The Occupational Safety and Health Act of 1970 - provides the requirements on which each Federal Agency's safety and health program is based.

- The Comprehensive Drug Abuse Prevention and Control Act of 1970 - establishes the mechanisms for reducing the availability of controlled substances and the procedures for bringing a substance under control.

- The Resource Conservation and Recovery Act (RCRA) of 1986 - directs the Environmental Protection Agency to develop and implement a program to protect human health and the environment from improper hazardous waste management practices.

- Executive Order 12196 (1980)- directs each Federal Agency to provide a safe and healthful working environment for its employees.

- 29 CFR 1910.1000, Subpart Z - provides tables listing toxic and hazardous substances and maximum exposure levels.

- 29 CFR, Part 1910.1200 (Revised 1987) - provides specific guidance on implementing the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard.

- 29 CFR 1910.1450 (Effective 5/1/90) - provides guidance relevant to occupational exposure to hazardous chemicals in laboratories.

- 29 CFR 1910.1047 (Revised 1985) - regulates the use of the fumigant ethylene oxide.

- 29 CFR 1960 - provides basic program direction for Federal Employee Occupational Safety and Health Programs.

- The Department Manual, Part 485- establishes the Department of the Interior (DOI) safety and health program.

- NPS-14, Cave Radiation Safety and Occupational Health Guideline - provides guidance on establishing precautionary procedures for cave radiation in order to minimize potential health hazards.

- NPS-50, Loss Control Management Program Guideline - provides guidance on the procedures for a park's health and safety program.

- NPS-77, Natural Resources Management Guideline, Chapter 2 - provides an overview of the integrated pest management concept and of NPS and Departmental policies concerning the use of pesticides, and procedures for applying for approval to use pesticides.

B. SOURCES OF ASSISTANCE

1. The Federal agencies that regulate aspects of the National Park Service health and safety program are as follows:

   - Occupational Safety and Health Administration (OSHA) - publishes and enforces safety and health regulations for most businesses and industries in the United States.

   - National Institute for Occupational Safety and Health (NIOSH) - trains occupational health and safety professionals; conducts research on health and safety concerns; and tests and certifies respirators for work place use.

   - Environmental Protection Agency (EPA) - administers laws to control and/or reduce pollution of air, water, and land systems; regulates use and labelling of pesticides in accordance with the Insecticide, Fungicide and Rodenticide Act of 1972.

   - Department of Transportation (DOT) - regulates the labeling and transportation of hazardous materials.

2. In addition to the above Federal agencies, park staff should be aware of the following professional organizations that are involved in health and safety management:

   - The American Conference of Governmental Industrial Hygienists (ACGIH) develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

     American Conference of Government Industrial Hygienists
     6500 Glenway Avenue, Bldg. D7
     Cincinnati, OH 45211
     513-661-7881

   - The National Fire Protection Association (NFPA), a voluntary membership organization, promotes and improves fire protection and prevention. The NFPA publication Standard No. 704, "Identification of the Fire Hazards of Materials," rates the hazard of a variety of materials during a fire.

     National Fire Protection Association
     Batterymarch Park
     Quincy, MA 02269
     617-770-3000

   - The National Safety Council educates and influences people to adopt safety and health policies, practices and procedures to prevent losses caused by accidents and hazardous occupational or environmental exposures.

National Safety Council
444 North Michigan Avenue
Chicago, IL 60611
312-527-4800

- The American National Standards Institute (ANSI), a voluntary membership organization, develops consensus standards nationally for a wide variety of health and safety devices and procedures.

  American National Standards Institute
  1420 Broadway
  New York, NY 10018
  212-354-3300

3. In addition to the Park Safety Officer, the Regional Safety Officer, the Regional Curator, and the WASO Safety Services Division, the following organizations have extensive experience in dealing with occupational health and safety issues/problems in the workplace, including museum work environments:

   Center for Occupational Hazards (COH)
   Dr. Michael McCann
   5 Beekman Street
   New York, New York 10038
   212-227-6220

   Arts, Crafts and Theater Safety (ACTS)
   Ms. Monona Rossol
   181 Thompson Street, No. 23
   New York, New York 10012
   212-777-0062

C. COMPARISON OF TYPES OF VENTILATION SYSTEMS

The advantages and disadvantages of the two types of ventilation systems - dilution ventilation and local exhaust ventilation - are illustrated in a chart on page 25 of Ventilation, A Practical Guide. This book, listed in Chapter 11, Section H, is available from the following source:

Center for Occupational Hazards (COH)
5 Beekman Street
New York, NY 10038
212-227-6220

A copy of this chart should be inserted in this section.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

D. SOURCES OF HEALTH AND SAFETY EQUIPMENT AND SUPPLIES

There are several sources for obtaining desk fans, fume hoods, portable fume hoods and fume scrubbers, laboratory protective clothing and gloves, respirators, chemical storage cabinets, health and safety publications, hazard warning labels, signs, and charts, and other supplies. NPS parks and centers should contact the Curatorial Services Division, Washington Office, for a copy of a list of sources for health and safety equipment and supplies.

E. LIST OF FUMIGANTS USED IN MUSEUMS

The Center for Occupational Hazards (COH) has prepared a chart that lists some of the common fumigants used in museums. This chart is available in the data sheet, "Safe Pest Control Procedures for Museum Collections by Perri Peltz and Monona Rossol. The chart titled "Hazards of Fumigants" lists the registered name, synonyms, trade names, appearance and warning properties, important health information, and reactivity information for the fumigants: carbon disulfide, carbon tetrachloride, dichlorvos (Vapona®), ethylene oxide, hydrogen cyanide, methyl bromide, naphthalene, para-dichlorobenzene, and sulfuryl fluoride (Vikane®).

Health related information in the chart includes: OSHA/ACGIH standards, routes of entry, signal word, acute health effects, chronic health effects, carcinogenic effects, and reproductive effects. Reactivity information relates how each fumigant reacts with the material fabric of objects.

A copy of this chart should be obtained from the below source and inserted in this appendix.

Center for Occupational Hazards (COH)
5 Beekman Street
New York, NY 10038
212-227-6220

APPENDIX I. CURATORIAL CARE OF ARCHEOLOGICAL OBJECTS

APPENDIX I. CURATORIAL CARE OF ARCHEOLOGICAL OBJECTS

A. THE NATURE OF ARCHEOLOGICAL MATERIALS

Any object that has been recovered from an archeological site is considered archeological material. This appendix only provides guidance only on the care of objects excavated from the ground. Care of collections from wet sites or marine excavations is not addressed. For guidance in these areas, consult an archeological objects conservator with field experience in the treatment of wet materials.

Depending on the soil and climate characteristics of the site, a wide variety of organic and inorganic objects may be recovered from an archeological excavation. These materials include inorganic materials such as metal, ceramics, glass and stone; and more infrequently, organic materials such as leather, basketry, and textiles. In addition, historic archeology has brought modern plastics and synthetics into archeological collections. Non-artifactual objects or "ecofacts", such as botanical material, pollen, phytoliths, oxylate crystals, snails, insect remains and parasites, are increasingly collected as a result of archeological research designs.

Because the research value of archeological material may be compromised or destroyed by unnecessary handling and inappropriate treatment, <u>preservation of these materials should be based on preventive care</u>. Careful handling, packaging and storage of archeological objects are crucial for the survival of the material as an "artifact" rather than as a mass or lump of stable compounds produced by the ongoing processes of deterioration.

The condition of all these objects depends directly on how the materials have reacted to the environmental conditions to which they have been exposed. Archeological materials have been exposed to complex environmental variables. First, the object in an underground context reaches a certain equilibrium with the surrounding soil. Then, when the object is excavated, it must adjust to an entirely new set of environmental conditions. Reactions to both events involve physical and chemical changes. Depending on how the material has reacted or equilibrated to a particular underground context, the object, at the moment of excavation, may be extremely fragile, or quite well-preserved. At the time of excavation, the object also can be particularly vulnerable to rapid deterioration. Figure I.1 illustrates the deterioration rate of archeological objects through time according to the episodes that encourage deterioration of the material.

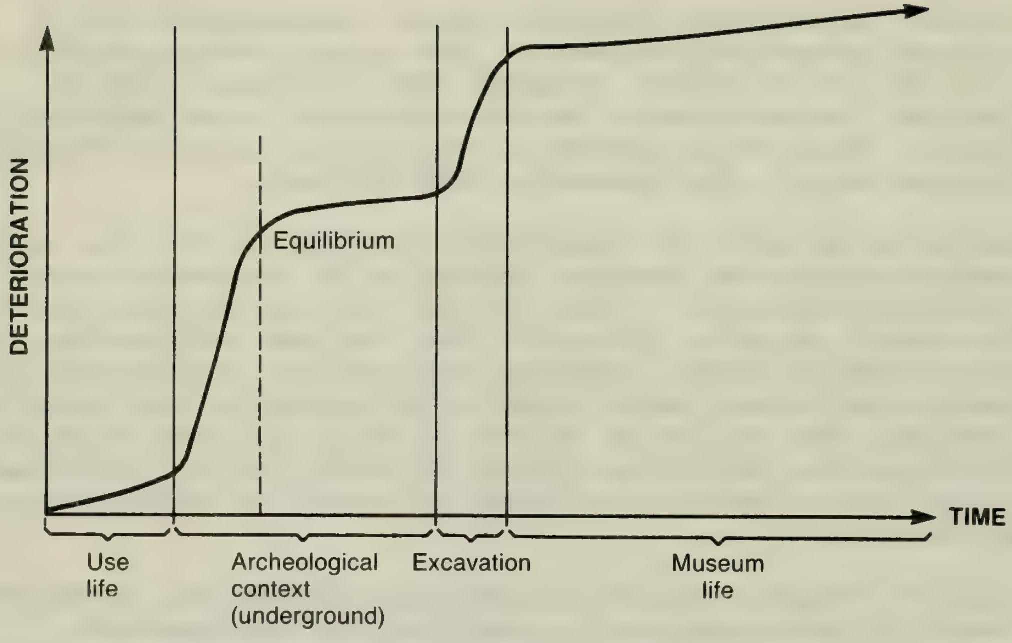


Figure I.1. Deterioration Through Time of Archeological Objects

At the moment of excavation, all materials, whether organic or inorganic, are vulnerable to accelerated deterioration. Therefore, preservation must begin by observing correct archeological procedures in the field and in the processing laboratory, and then, continue by proper curatorial care in museum collections storage. Refer to NPS-28, Cultural Resources Management Guideline, for guidance on the responsibilities of the archeologist before placing collections in a repository and in selecting an appropriate repository, and to Special Directive 87-3, Conservation of Archeological Resources, for park management's responsibility to ensure appropriate care and management of archeological collections.

B. HANDLING ARCHEOLOGICAL MATERIALS

Because archeological objects can be deceptively fragile, all unnecessary handling should be avoided. All excavated materials have undergone some form of alteration during the equilibration process in the underground context and in the recovery process that has resulted in the physical weakening of the object. It is important to note that, while underground objects are completely supported by the surrounding soil, when excavated, they may be unable to support their own weight. For this reason, archeologists often use specialized lifting techniques to excavate fragile and potentially fragile objects to ensure that they will never have to bear their own weight. During and after excavation, these objects must be supported on a tray, pallet, or in a container that distributes weight properly.

In the case of existing archeological collections, always assume that any excavated object is weak rather than strong. Review the guidelines for handling museum objects in Chapter 6. Keep in mind the following added rule:

- An archeological object <u>must always</u> be fully supported. Use both hands, or a tray or supporting container to lift and carry these objects, whether the object is large or small.

C. CLEANING ARCHEOLOGICAL OBJECTS

Cleaning of archeological material by archeologists, curatorial staff, and even by conservators, should be kept to the lowest level necessary to achieve a valid goal. **It is important to note that any cleaning method, no matter how simple, is irreversible and may destroy important archeological evidence.** Surface decorations and composite or associated materials often exist only as impressions on the surface of the object or in the surrounding soil. Original surfaces of metal objects may actually lie within layers of corrosion. Moreover, evidence of use (e.g., food residue in containers, pigment traces on stone palettes, or blood traces on stone projectile points) may be destroyed by unnecessary or inappropriate cleaning. Cleaning also may interfere with the application of scientific methods of analysis. For example, the use of acid to remove dirt deposits on ceramics also may remove acid soluble compounds in the ceramic paste, thereby invalidating composition analysis often used for determining the prehistoric source of clay. Even washing ceramics in water may remove water soluble material that was part of the original clay paste. Water washing will remove amino acid traces now used to date bone. Wet cleaning may also encourage deterioration of salt contaminated material and can be disastrous to metal objects when not followed by complete and controlled drying.

The above examples demonstrate the importance of minimal intervention in the treatment of archeological materials. Because the rapid advance of technology makes accurate assessment of the research potential of archeological objects difficult, any treatment that alters the chemical or physical integrity of these objects should be avoided whenever possible. Even traditional treatments previously considered "routine," such as washing, should be reevaluated in terms of the real necessity of treatment versus the danger of loss of information and possible irreversible damage to the object.

Therefore, at the level of curatorial care, it is best to avoid washing procedures altogether, and to remove only loose dust and dirt by dry brushing or controlled vacuuming. Remember that the surface of archeological objects is often fractured, friable or otherwise easily dislodged by rubbing or application of pressure. As a general rule, carefully assess the object's surface before starting any cleaning procedure. If the archeological significance, present condition, and intended use of the object require treatment beyond brushing away loosely adherent dirt, additional cleaning, stabilization, or repair should be conducted only by or with the advice of a conservator experienced in the treatment of archeological material.

D. PREVENTIVE CARE: ENVIRONMENTAL REQUIREMENTS

Because archeological collections are often large and contain a variety of materials with different environmental storage requirements and with different degrees of academic significance, a systematic approach to managing these diverse collections should be taken to ensure basic preservation of all materials.

Traditional physical organization of the collections by provenience data or by cultural affiliation data may not correspond with their preservation needs. When different materials require different environments for optimum preservation, it is best to maintain the academic integrity of the collection through proper museum record keeping procedures, while maintaining the physical integrity of the collections by organizing the materials according to their environmental requirements and storing them accordingly.

Applying this preservation approach, archeological materials may be ranked in the following three categories:

1. <u>Category I - Negligibly Climate-Sensitive Materials</u>

   a. Materials:

      - stable fired ceramics and stone
      - stable inorganic architectural materials (e.g., plaster, mud daub, brick, and stone)
      - dry pollen, flotation, and unprocessed soil samples
      - faunal remains

   b. Climate Requirements: Daily and seasonal fluctuations of both temperature and relative humidity should be as gradual as possible.

      - **Relative Humidity:** Above 30% and below 65%. Mold may become a problem above 65%.

      - **Temperature**: Anywhere from freezing to 100°F. Moderate and cooler temperatures (below 70°F) are preferable because higher temperatures speed up rates of deterioration of all materials.

2. <u>Category II - Climate-Sensitive Materials</u>

   a. Materials:

      - stable metal
      - stable glass
      - worked bone, antler and shell
      - botanical specimens
      - textiles
      - wood

- skin, leather and fur
- feathers and horn
- natural gums, resins, and lacquer

b. Climate Requirements:

Relative Humidity: A stable point determined by the object's environmental history and current regional climatic considerations. Consult a conservator for the optimum relative humidity for collections in the park's area. Assuming that the collections will be stored in the general area from which they were excavated, the following broad guidelines for relative humidity may be followed:

30-40%: Semi-arid areas and deserts
40-50%: Central and eastern plains and woodlands
45-55%: Seacoast and lakeshore

Once the appropriate RH% is determined, it is important to keep conditions as stable as possible. Many organic materials are more sensitive to fluctuations of relative humidity than to any one unchanging level in the moderate range. Keep the RH% as steady as possible, with fluctuations ideally no greater than 3% in one day. Seasonal fluctuations should be as gradual as possible, and should not exceed more than a slow 10% drift in relative humidity from summer to winter.

Temperature: Above 50°F and below 75°F. Temperature may be allowed to drift to keep relative humidity steady, but sudden changes of more than 5 degrees daily should be avoided.

3. <u>Category III - Significantly Climate-Sensitive Materials</u>

a. Materials:

- unstable (salt-contaminated) ceramics and stone
- unstable glass (e.g., devitrified glass that appears damp or "weeping" due to chemical alteration during period underground and the subsequent dissolution of compositional elements)
- unstable metal, particularly iron
- mummified human and animal remains
- composite objects (objects made of several different materials)

b. Climate Requirements:

Relative Humidity: These objects require a restricted range of relative humidity, and often have no tolerance for fluctuation in ambient conditions. Although the requirements of each object will be dictated finally by specific conditions, the following general guidelines apply to broad categories of significantly climate sensitive materials:

Metal:	Under 30% RH. Unstable iron is best stored in conditions of below 15% RH.
Unstable glass:	30 to 40% RH.
Naturally mummified animal remains:	15 to 20% RH.
Unstable ceramics and stone (salt-contaminated):	Below 50% Most importantly, keep the RH stable. Salts have a critical point of moisture attraction when they transform from the crystal state to the liquid state. The critical point for combined salts is lower than that of individual salts alone, and it is difficult to recommend a standard RH level for all unstable ceramics and stone. Keep the RH as steady as possible to avoid continued damage by the hydration cycling of soluble salts.

Temperature: A steady point chosen between 60-72°F. Temperature fluctuation should be minimal, but may be allowed to drift within a 2 to 3 degree range to keep relative humidity steady.

E. PREVENTIVE CARE: STORAGE OF ARCHEOLOGICAL OBJECTS

Ideally, all archeological objects should be stored in climate-controlled areas, but in reality, this often is not practical. Most archeological collections are large, and not all storage facilities can afford the luxury of having an equally large climate-controlled storage space available to house collections. In such cases, it is possible to maximize preservation while minimizing utility costs by implementing a storage strategy based on the environmental requirements of archeological materials. See Section D of this appendix for a discussion of environmental requirements. Three levels of storage corresponding to the three categories of climate-sensitivity can be established, and various storage techniques can be used to moderate extremes and shifts of environmental conditions.

1. Three Levels of Storage

a. General Storage (Category I Materials)

General storage should meet the minimum overall standards for all NPS storage spaces as outlined in Chapter 7.

Many of the materials that can be placed in general storage can be stored in boxes on open shelving. Loose material such as bulk botanical specimens, unprocessed soil samples, dry pollen and flotation samples, slag, unworked bone, lithic cores and debitage, and ceramic sherds should be bagged within the boxes. Make sure that the bag is strong enough to hold the contents without tearing or puncturing. Bags made of Tyvek®, a strong spun polyethylene plastic that permits the passage of water vapor, is a good choice for this type of material. Canvas bags and resealable polyethylene bags also can be used.

b. Climate-Controlled Storage (Category II Materials)

Storage specifications for Category II materials should comply with the optimum standards for NPS storage areas as outlined in Chapter 7. Once the climate-insensitive material is separated out for general storage, the area needed to house this category of materials may be considerably smaller and, therefore, less costly to maintain.

If there is no area available in the structure that is able to maintain a steady environment either naturally or by means of a mechanical system, consider the installation of a climate-controlled prefabricated structure for storage of climate-sensitive materials. Consult the Regional Curator, conservators specializing in environmental or preventive conservation, or the Curatorial Services Division, WASO, for guidance in developing a climate-controlled storage area.

c. Microclimate Storage (Category III Materials)

Within the climate-controlled storage area, specialized microclimates can be created for the storage of extremely climate-sensitive and unstable materials. Microclimates can be created simply by placing the object within a closed well-gasketed museum cabinet to slow down the diffusion rate of air exchange between the interior and exterior of the cabinet. If the environmental conditions in the storage area are already fairly steady as specified in Chapter 7, conditions within the case should be extremely stable with virtually no fluctuations of relative humidity.

However, the preservation of some excavated material like metals and unstable glass, depends on the maintenance of a relative humidity quite different from ambient conditions within the climate-controlled area. Microclimates for these specialized needs can be created by housing these materials in special containers with moisture sensitive materials called <u>sorbents</u> to dessicate, ballast or buffer the interior of the container against changes in the preferred relative humidity of the objects enclosed. All organic materials, particularly cellulosic materials such as wood, textiles, and paper, are able to condition their immediate environment by absorbing and giving off moisture to maintain an equilibrium between their own moisture content and ambient conditions. The most efficient sorbent, however, is <u>silica gel</u>.

2. <u>Storage Techniques</u>

a. Packaging with Silica Gel

Silica gel is inert amorphous silicon dioxide in a porous granular form that is able to absorb (or more precisely, to <u>adsorb</u>) moisture from the air. Because of its structure, silica gel is able to absorb 30-40% of its dry weight in water, and responds more quickly than other sorbents (e.g., wood, textiles, paper) to variations in relative humidity that are different from the level of moisture to which the gel has been accustomed or "conditioned". The gel rapidly senses, corrects, and stabilizes fluctuations in relative humidity by humidifying or dehumidifying the air around it to maintain its own preferred environment.

Several types of silica gel are commercially available. The particle size of gels normally used for conditioning museum exhibit and storage cases is 3-8 mesh, grades 01 or 03. Each type has characteristic adsorption capacities within certain ranges of relative humidity. For example, regular density silica gel RD03 made by W. R. Grace and Co., Davis Chemical Division, has a very high adsorption capacity below 50% and is, therefore, a good choice for creating a dry microclimate for unstable metals. Intermediate density silica gel ID59, also from W. R. Grace and

Co., has a very high adsorption capacity between 70% and 100% RH, and is much more efficient than regular density gel in buffering changes within this range. However, few objects require microclimate storage with such high and mold-threatening RH, and this gel is most often used in combination with other grades.

Art-Sorb made by Fugi-Davison Chemical, Ltd., is a silica gel in round bead form that is particularly suited to buffering changes in the mid-range of 40-60% RH, and is, therefore, quite useful in most museum applications. Art-Sorb is also available in convenient premeasured, preweighed amounts enclosed in open-grid plastic tiles covered with a thin membrane of Gore-Tex® breathable teflon plastic. These tiles are easy to use, but somewhat expensive.

Flat sheets made of porous polyethylene-polypropylene plastic infused with silica gel powder from crushed Art-Sorb beads are also available. <u>All silica gel works most efficiently if spread out for maximum surface exposure</u>. Art-Sorb sheets capitalize on this principle for maximum rapid response. However, the conditioning power of the sheets is easily exhausted as they drift to recondition themselves with ambient relative humidity. The sheets are most useful in conjunction with other buffering materials in short-term applications, such as packaging objects for shipping.

Arten Gel® is another product that combines a gel capable of rapid response to sudden fluctuations in relative humidity with slower gels that act as a reservoir to buffer long term changes, while continuing to condition the fast reacting gel component. Because of its versatility, this gel is a good choice for long-term microclimate storage of unstable and extremely climate-sensitive materials.

Silica gel in all forms can be conditioned by spreading the gel on trays and placing it in a room known by the park's curatorial staff to have the desired RH%, or by placing the gel in an environmental control chamber for two weeks. However, the efficiency of all gels will decrease over time at a rate dependent on the exchange of air between the sealed container and the exterior room, and the innate characteristics of the chosen gel. To know when this happens, monitor the interior of the container with a humidity indicator strip. Use a clear plastic container such as a polystyrene or polycarbonate sweater box or nearly transparent freezer container with tightly fitting snap-on lids to house the material while allowing easy viewing of the enclosed humidity indicator strip.

Heat sealable clear plastic laminate films with excellent vapor barrier characteristics are now commercially available, and are very useful for making microclimate storage bags for large and awkwardly shaped objects. The plastic is a laminate of mylar and other stable plastics, and is easily heat sealed using a teflon

bar heat sealer or household iron. Bags can also be sealed with pressure sensitive polyethylene tape applied over a double fold. NOTE: **Avoid the use of pressure sensitive tapes in other applications.** Because the plastic is clear, the humidity indicator card enclosed within can be easily seen without opening the bag.

When the enclosed humidity card indicates that the gel's buffering capacity has drifted, replace it with fresh gel, and recondition the old gel as described above. A reserve supply of premeasured silica gel packets should be prepared and stored in airtight containers for quick replacement of the exhausted gel. The gel can be completely dried by placing it in an oven (300-350°F) for two or more hours, depending on the amount of gel to be dried, or by microwaving at low power for at least 5 minutes. Spread the gel thinly in plastic dishes if microwaving, and in metal cake pans or cookie sheets if placing in a conventional oven. Dry the gel completely when using it to store archeological iron objects. NOTE: Iron objects should be kept as dry as possible.

Premeasured packets of silica gel can be made by using fairly open weave lightweight washed muslin bags that are broad and flat like small pillow cases. Velcro® can be attached to one end so that the bag may be easily opened to regenerate the gel, filled again, and reclosed. Gore-Tex® and perforated Tyvek® can also be used for making bags. Clear resealable polyethylene freezer bags can be used as well by punching plenty of holes in the bags smaller than the grain size of the gel. A mixture of indicating gel (cobalt chloride impregnated gel that turns from blue to pink as humidity increases) and regular gel within clear plastic bags makes it easy to see when the gel needs regeneration without a humidity indicator card. This may be useful for objects like iron that need a dry environment, but perhaps less useful for objects requiring a set RH% level within the moderate range. Label all premeasured silica gel packets with the dry weight, date, and RH% of preconditioning.

The amount of silica gel used in a closed container depends on the volume of the container. The most common mistake in using silica gel is to use too little. It is better to use too much silica gel in a container than not enough. Twenty kilograms of silica gel per one cubic meter, or 5 lbs. of gel per cubic yard, is usually considered a sufficient amount. Once the initial calculations are made, use standard sizes of containers to streamline the production of premeasured silica gel packets.

Within the container, the object should never be in direct contact with the silica gel. Make sure that there is always a barrier between the object and the gel, but remember that the gel is most effective with maximum surface exposure, and organize the contents of the container accordingly.

b. Standard Boxes

There are many different types of standard boxes that are appropriate for storing archeological material. For example, boxes manufactured for the storage of archival and photographic collections are well suited to the storage of small objects like lithic points and nails. Small resealable polyethylene bags can be used for each individual specimen, and stacked vertically within each section of the box. Include an acid-free tag with the identification number inside the bag as well as writing the number in a standard location on the outside of the bag. Small objects may also be enclosed in a small self-sealing bag and stapled to a 3"x5" or 5"x8" notecard containing the provenience data and catalog information. The notecards can then be stored in a standard archival quality file box. Refer to Figure I.2.

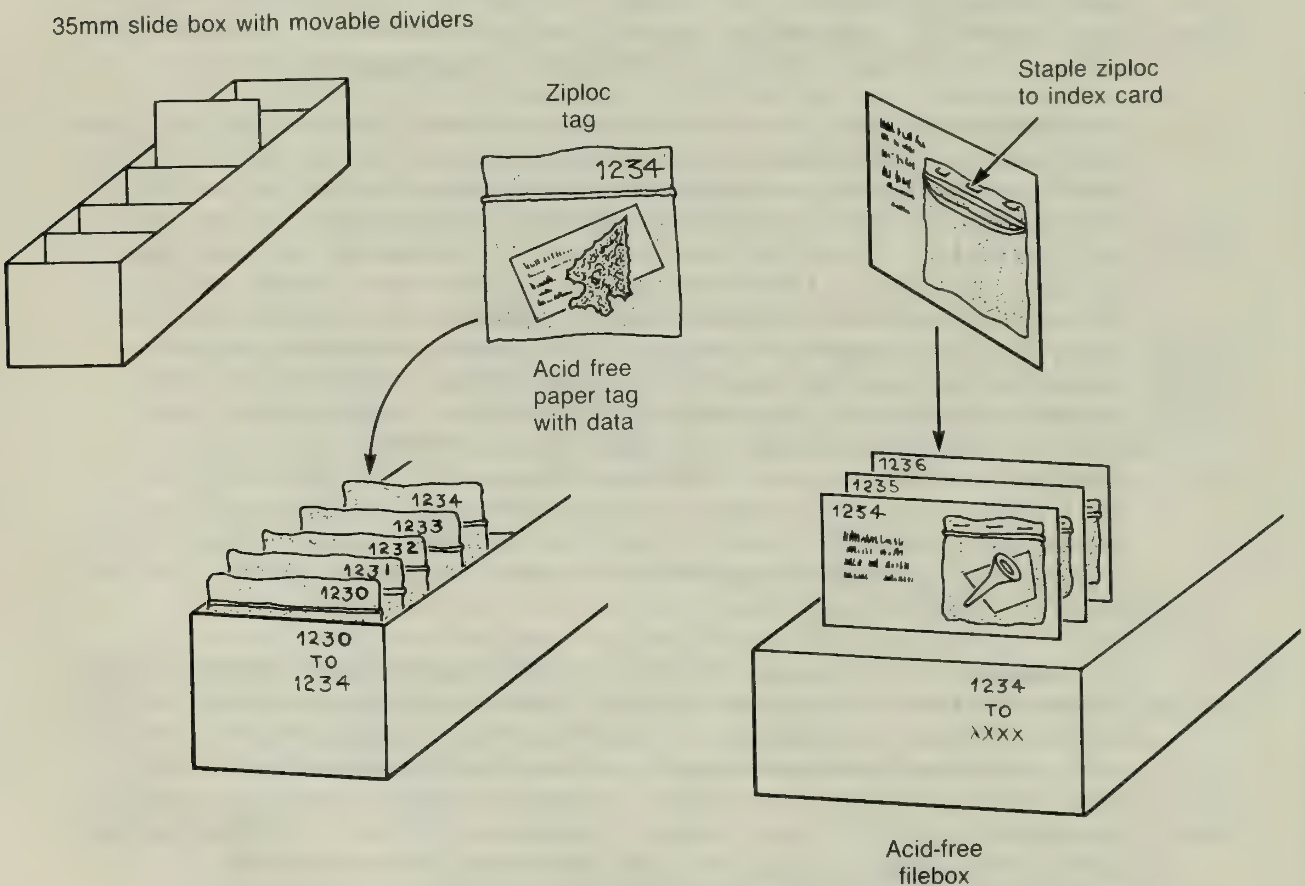


Figure I.2. Vertical Stacking of Small Objects Within Standard Containers

Acid-free boxes with lids are preferable to self closing boxes because the contents are more easily available without destroying the integrity of the box by cutting or peeling back tape, or repeatedly folding back flaps.

Be as consistent as possible in packaging objects within a box so that staff and researchers can predict the orientation of objects within closed containers to minimize accidental mishandling during retrieval. Include written descriptions and/or drawings of packing techniques with the supporting documentation of the collection to narrow the possibility of damage to the object during unpacking. Consider placing description of the packing technique on inside of the box lid. Easy visual access is important. Objects should never be wrapped or wound in padding material making excessive handling necessary to retrieve the object.

1) Padding

Padding material within the box should prevent contents from shifting if the box is moved or handled carelessly. Avoid overstuffing the box with crumpled tissue or other padding material that could exert damaging pressure against the objects enclosed, or hinder easy access to the contents. Crumpled paper wads expand to fill the space in which they are placed, and press against the surface of the object. This situation can cause damage when the object is removed from the box, or when stuffing is removed from the interior of an object, particularly if the object has a fragile surface or brittle projections that are easily snagged and broken.

Instead of crumpling wads of tissue paper, make smooth pillows by wadding acid-free unbuffered tissue paper and folding the wads in a loose roll of tissue to make a smooth surfaced pad to place against the surface of the object. Wrapping crumpled wads in tissue also restricts the expansion of the crumpled paper, and may alleviate expansion pressure against fragile surfaces.

Sandwich size resealable polyethylene bags filled with cotton balls also make good padding and support material for fragile objects. Cotton or polyester wool alone should not be used in direct contact with any object. Cotton is an excellent sorbent, and may hold moisture directly against the object, encouraging moisture related problems such as corrosion and mold. Cotton fibers also easily snag and entwine artifact elements, making separation of the object from the cotton difficult without damaging the object.

2) Organization of Box Contents

Regardless of size or type of box, it is important to organize the contents to make retrieval of specific items easy without rooting through the contents of the box and possibly damaging fragile material.

One strategy is to organize the box into distinct layers. If the contents are lightweight, such as cordage fragments or botanical specimens, they can be organized into three or four

layers depending on the size of the specimens. Heavier objects should always be on the bottom layer. Museum specimen trays, listed in the NPS Tools of the Trade, can be used in each layer to make the lifting of contents easier. Interleave the layers with a sheet of polyethylene foam shelf liner, also listed in Tools of the Trade. The foam will serve as a clear demarcation between layers as well as providing cushioning. Refer to Figure I.3. Acid-free boxes with fitted trays equipped with adjustable interior compartments are now manufactured by museum supply companies, and are ideal for the storage of archeological material.

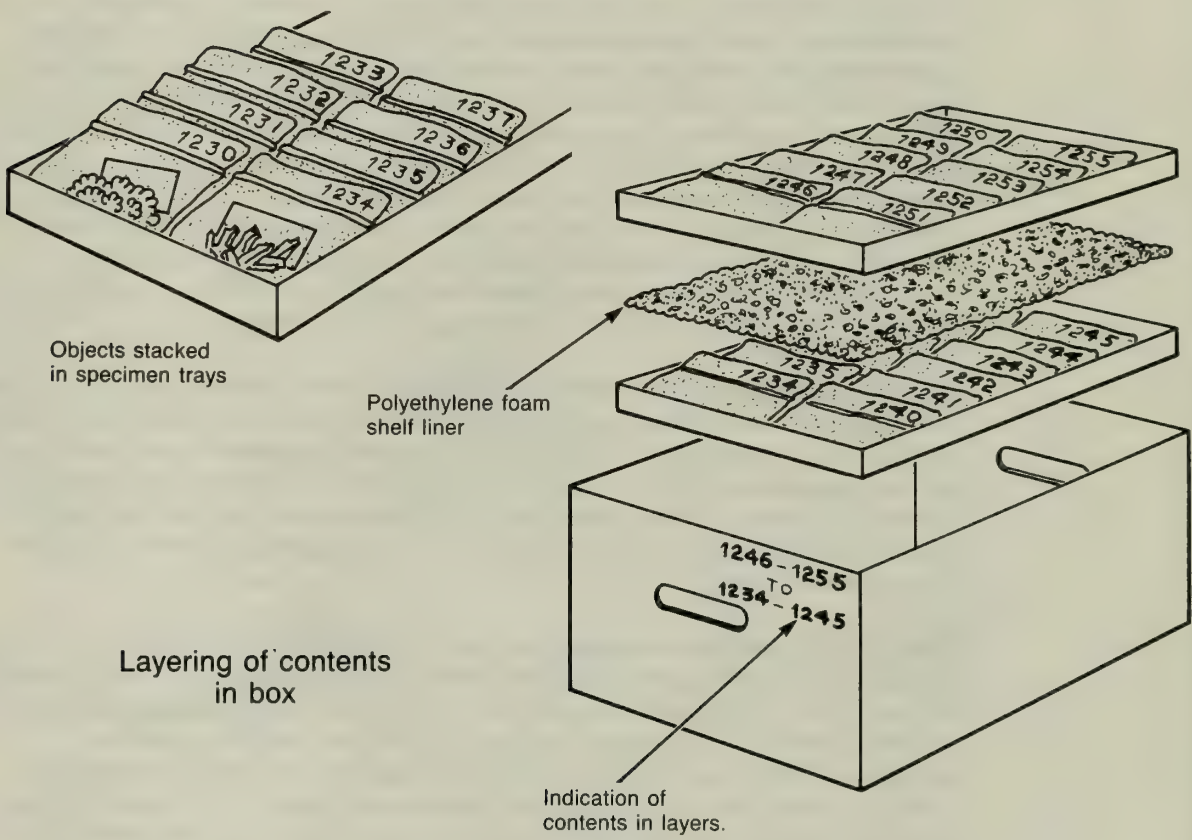


Figure I.3. Organization and Layering of Objects within a Storage Box

3) Inventory of Contents

Small objects should be individually bagged in small resealable polyethylene bags. Include an acid-free paper tag with field data or catalog number written in pencil or water-proof India ink within each bag. Stack the bags in each layer like fanned out playing cards, with identification numbers written on the top of each bag for easy reference. Identification numbers should be written on all bags as well, and should be visible

when the bags are stacked and fanned out to avoid needless handling when locating a specific item.

Identification numbers of the contents should be written on the outside of the box by layers, and a more detailed list of the contents of each box should be prepared and placed on top of the contents in the box.

c. Support Trays for Objects

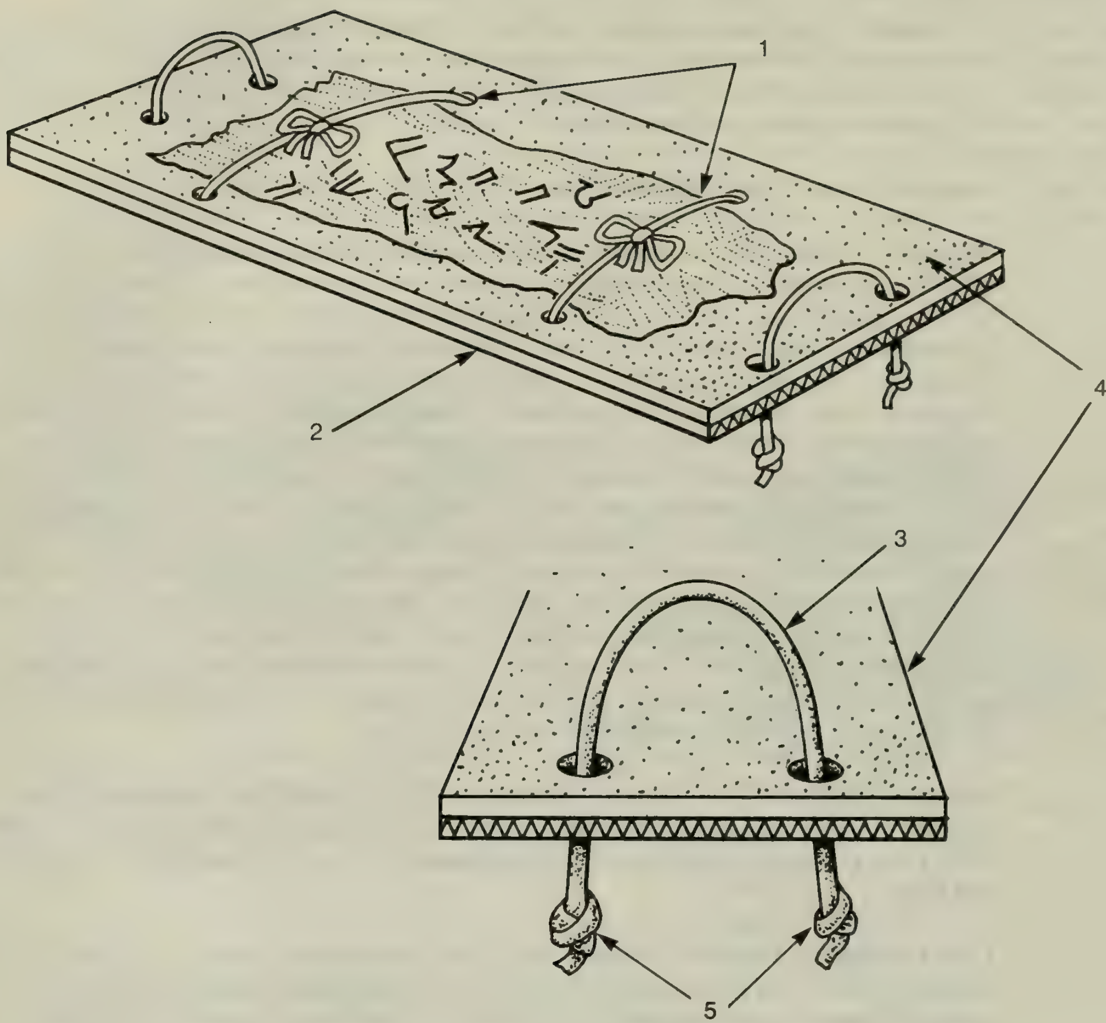
Remember that all archeological objects should be handled and moved by means of a supporting tray or container. The support can be as simple as the standard museum specimen trays supplied by the Curatorial Services Division's Museum Equipment and Supply Program. If the object is too large to fit a standard tray, a support tray can easily be made from a padded acid-free corrugated cardboard or other rigid board fitted with handles of cotton twill-tape threaded through punched holes as illustrated in Figure I.4. Depending on the weight of the object, there are many boards including cardboard, foamboard, and honeycomb board, that can be used for making support trays. Make sure to select a board that will remain rigid while bearing the weight of the object to avoid sagging and a trampoline effect that could damage rather than successfully support the object. For added security, tie the object to the tray with cotton twill tape. Tie the tape in a bow so that it is easily untied.

Support trays also can be fitted with customized supports for objects with fragile surfaces such as delaminating glass. Figure I.5 illustrates the use of Ethafoam® blocks to support a fragile bottle.

Ethafoam®, a stable closed-cell polyethylene foam, is useful for making both tray supports and trays with cavities for fragile three-dimensional objects. Electric carving knives are useful for cutting large blocks of Ethafoam®. Cavity packing is a good technique to use when the object must be moved periodically for research or other purposes, or when the object has no even footing and needs support to keep it stationary. Make sure that the fit of the object in the cavity is not too tight, and that the object may be safely removed from the tray. If necessary, carve finger grips on either side of the object to assist in lifting the object from the tray. See Figure I.6.

d. Storage Mounts

Archeological objects are often weak due to deterioration during the underground period. They may require specialized supports to maintain their structural integrity. Before designing a specialized mount, evaluate the points of structural strength and weakness of the object. In order to assess the object, it is important to determine <u>what the object is, how the object was used</u>



1. Twill tape tied loosely in bows over object to secure it to the tie tray. The method of attachment should be both obvious and easily unfastened.

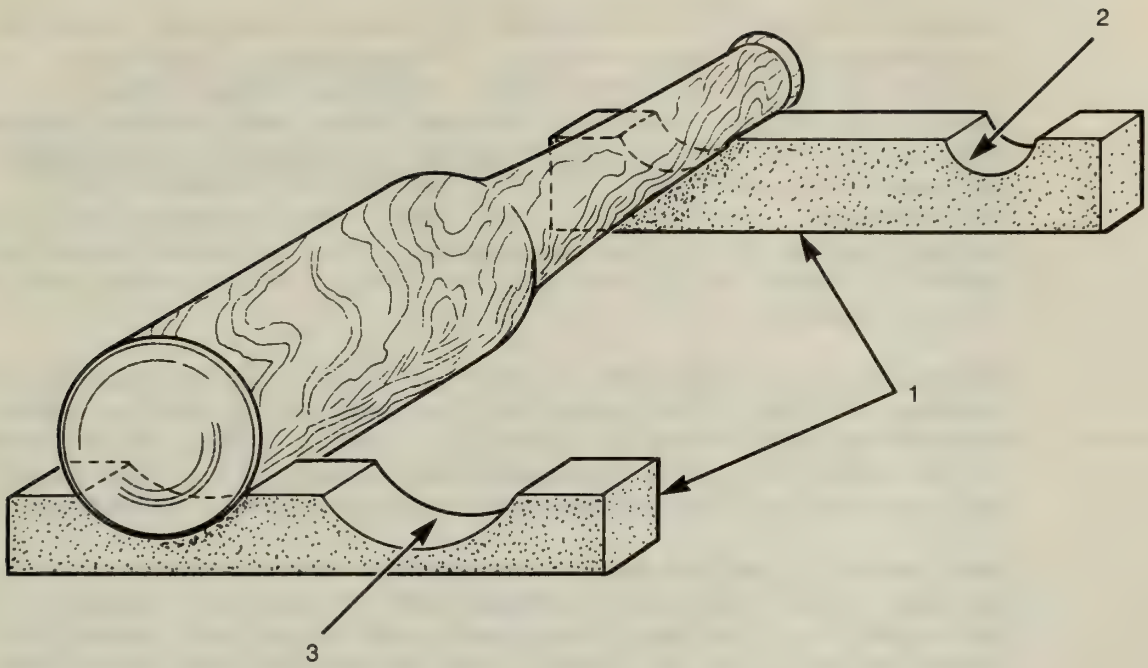
2. *Rigid board:* acid-free cardboard; fluted plastic, Fome-cor, Tycore.

3. Twill tape or nylon rope.

4. Line rigid board with a polyethylene foam pad. Cover foam with washed muslin or unbuffered acid-free tissue. Attach the lining to the board with a good quality double-sided tape (e.g., Scotch 415) or with a hot gun. If the support tray is small, the twill tape ties should be enough to hold both the pad and the object in place.

5. Knots *larger* than punched hole.

Figure I.4. An Easily Made Support Tray for Fragile Material



1. Use Ethafoam blocks to support complete ceramic or glass bottles. Ethafoam blocks can be placed in specimen trays on shelving or in museum specimen cabinet drawers.

2. Cut out wells in each Ethafoam block to fit the diameter of the neck and bottom of the bottle.

3. Because cut Ethafoam can be scratchy, line each well with strips of Tyvek or smooth foam sheets to protect the surface of the bottle from possible abrasion. Remember that the surface of iridescent excavated glass is particularly fragile. The bottle should never be made to fit tightly into the Ethafoam support.

Figure I.5. Customized Support Blocks For a Fragile Glass Bottle to be Fitted in a Museum Specimen Tray

or worn, and how the object was made. For example, conical-shaped baskets, which were often worn like backpacks, were used to carry objects, and consequently, load stresses were distributed down the sides of the basket and concentrated in the bottom. The rim is the weakest part of these baskets, and yet, they are most often stored upside down like traffic cones.

A successful storage mount takes into account the form and function of the object while minimizing any load or gravity stress that the weakened object is no longer able to bear. For objects with an unstable base, a cradle mount can be easily made to evenly distribute the weight of the object and keep the correct orientation of its use as originally engineered. See Figure I.7.

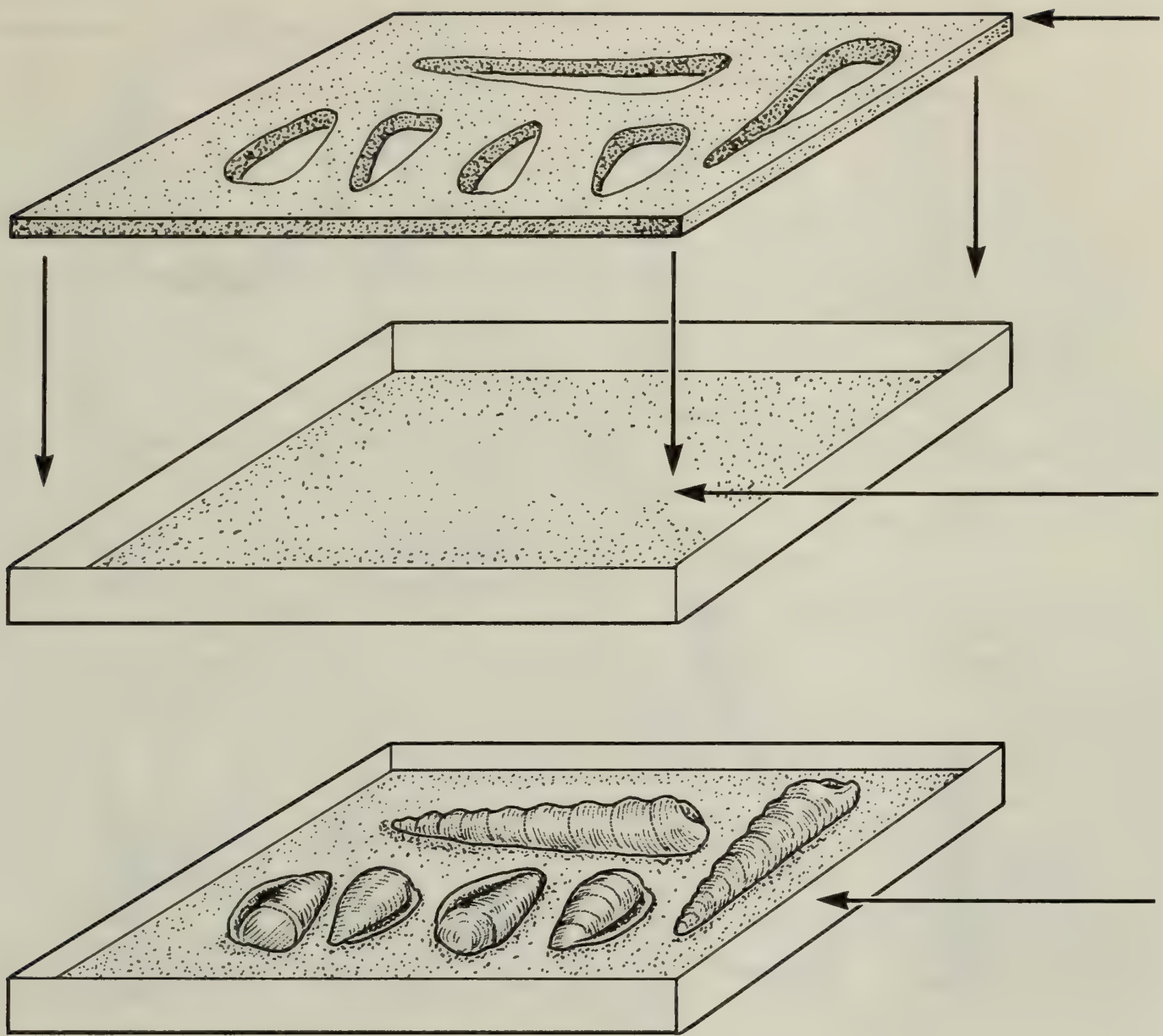
e. Special Containers

Consider the goals of the researcher before designing a special storage container for an object. For example, a container intended to house an archeological textiles fragment should protect the object from both dust and light, and perhaps provide some moisture buffering ability as well. However, a researcher may want to examine both sides of the textile without visual interference. The container must permit close examination of the contents while minimizing the need to actually handle the object. Portfolio mounts as illustrated in Figure I.8 are a good solution to this problem.

The technique illustrated in Figure I.8 also can be adapted to the storage of other "flat" objects like basketry fragments, thick cordage and other fragile materials. Simply adjust the thickness of the interior mat to accommodate the dimensions of the object and avoid any unsafe pressure or crushing of brittle elements.

When making a special box for an object, the same principle of maximum visual access and minimum handling applies. Support of the object is of primary importance, and the object needs to be supported on a tray by which it can be removed from within the storage box. Design or choose a box with a drop-front construction that allows the object to be slid out onto a stable surface rather than hoisted up and out like a turkey from a roasting pan. Think of the logistics of handling both the object and the container. Anticipate accidents when designing special containers and incorporate features and measures to protect the object from mishandling.

Special containers and mounts also may be necessary to protect fragile, unstable, and top-heavy objects from damage during an earthquake. It also is important to prevent objects and mounts from moving or shifting on shelves and within cabinets to maximize earthquake protection.



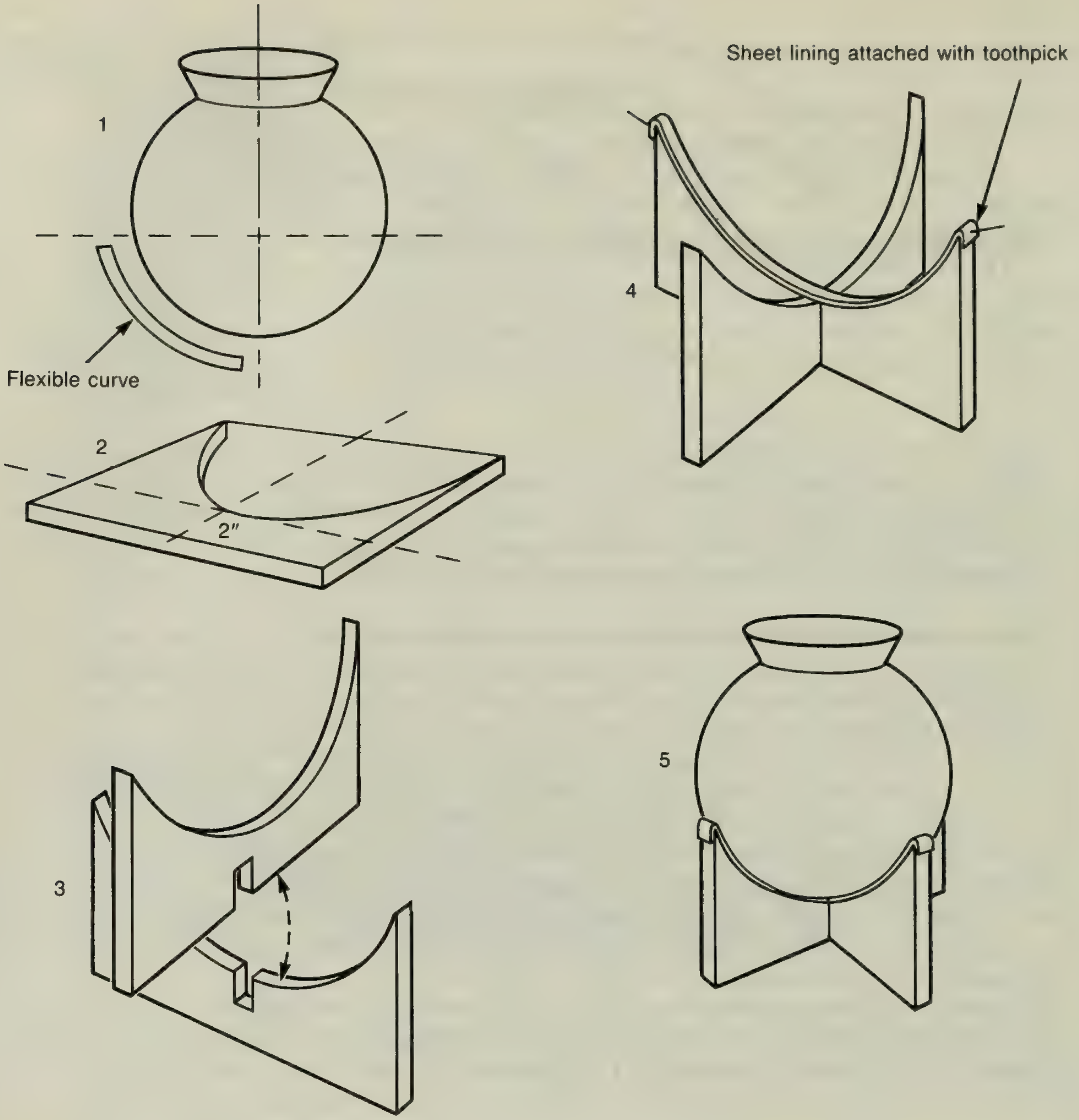
1. Isolating objects in separate cavities restricts movement and provides easy accessibility. A number of small objects may be accommodated in a museum specimen tray.

2. Line the bottom of a museum specimen tray with 1/4″ thick polyethylene foam.

3. Mark the outline of the object on a second sheet of 1/4″ polyethylene foam. Be very careful not to touch the object with the marking instrument. Avoid using a pen. With a freshly sharpened pencil, puncture the foam around the object and twist the pencil to obtain a clear mark in points about 1/4″ apart for small objects and 1″ apart or more for larger objects.

   Move the object out of the way, and cut out this shape by "connecting the dots" with an X-acto knife.

Figure I.6. Cavity Packing Technique for Small Objects



1. Starting from the center of the vessel, measure the curve from its base up to 1/3 of its height with a flexible drafting curve.

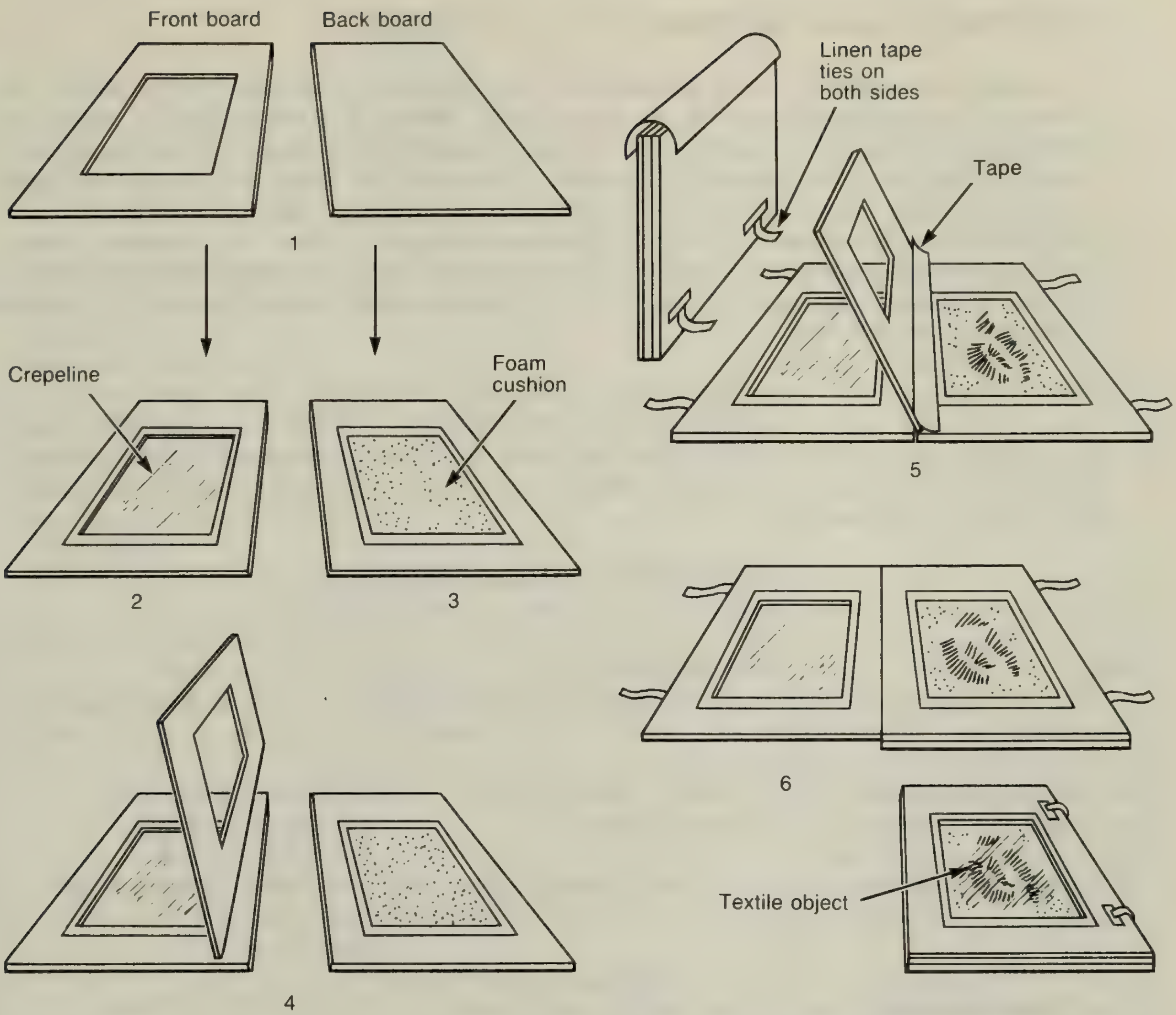
2. Use 1″ – 2″ thick ethafoam (thickness depends on the size of the vessel to be supported). Leaving 2″ at bottom of ethafoam sheet, mark the profiles of a full cross-section of the object. If the shape of the object is not too eccentric, flip measured curve on one side to the other side as illustrated. Cut cross-section profile out with a sharp knife. Repeat technique to produce another cross-section to be used to bisect the first one.

3. Cut a 1″ by 1″ notch in the center of the base of one cross-section as shown in 3A. Cut a 1″ by 1″ notch in the center of the top of the curve in the other cross-section as shown in 3B.

4. Fit both cross sections together at the notches. Cut thin foam sheet for lining the cradle surfaces. Pin foam buffering strips to cradle surfaces with toothpicks as shown.

5. Place vessel in the cradle.

Figure I.7. Construction of a Cradle Mount for Objects With Round Bases



1. Cut out front and back of portfolio from a sheet of museum quality mat board. Cut window out of one board. Make window 1/2″ to 1″ larger than the dimensions of the textile fragment.

2. Cover window with silk crepeline or polyester stabiltex. Pull taut over window opening and attach with water activated acid free linen tape.

3. Cut a piece of cushioning material (e.g. sentinel foam volora, microfoam) to the inside dimensions of the window. Place material on board. Cover the foam with a non-woven polyester fabric such as Reemay 2014 and attach with water activated linen tape.

4. Prepare a third board identical to the window front board. Use this board as a spacer to protect textile specimen from being crushed.

5. Stack the three boards. Attach water activated linen tape along the outside edge like a book-binding. Attach linen bias tape ties with water activated tape to the front and back boards. Open portfolio and attach center spacer with water activated tape.

6. Place textile fragment on cushion and close the portfolio. The silk crapeline window facilitates visual identification of specimen without having to open the mount and protects the textile specimen from dust.

Figure I.8. Construction of a Portfolio Mount for Archeological Textile Fragments

F. RECOMMENDED STORAGE MATERIALS

All materials used in the packaging of archeological material should be as chemically inert and stable as possible. This is particularly important for the storage of climate-insensitive materials frequently relegated to "benign neglect" in general storage. The initial packing might well be the only attention that it will receive for years, apart from basic housekeeping procedures in the storage space(s). For this reason, the packing materials should be of high quality, not so much for the benefit of the climate-insensitive materials, as for the longevity of the storage packaging itself.

The following list includes many (not all) materials that are suitable for long-term storage of archeological collections. Refer to the NPS Tools of the Trade and consult with the Regional Curator, conservators and the Curatorial Services Division, WASO, for sources of these materials and additional information.

RECOMMENDED STORAGE MATERIALS

USE	DO NOT USE	WHY NOT
Boxes:		
Acid-free document storage boxes (e.g., Hollinger® and other specialty archival boxes)	Liquor, grocery and cigar boxes	Unstable materials; potential insect infestation from previous contents and previous storage conditions
Good quality new cardboard boxes. Use for storage of bulk climate-insensitive material. (Available from GSA)	Used boxes with labels crossed out	Difficult to read what the current contents are through clutter of previous inventories
Clear polystyrene boxes (variable sizes)		
Polypropylene plastic containers		
Polyethylene plastic containers with snap-on lids		

RECOMMENDED STORAGE MATERIALS

USE	DO NOT USE	WHY NOT
Bags:		
Resealable polyethylene bags (e.g., Ziploc® also available from GSA, Baggies®, Whirl-pak®) Tyvek® (spun polyethylene bags, available from forestry supply companies)	Kraft lunch bags, waxed paper, envelopes	Unstable materials; waxed paper can transfer wax to object; no visual accessibility
Padding:		
Non-buffered acid-free tissue (neutral pH)	Buffered acid-free tissue	Possibility of influencing research chemical analysis by placing object in an alkaline environment
	Kleenex®, paper towels, toilet paper	Contain impurities; not durable
	Newsprint, newspaper	Very acidic; ink readily smears and can transfer to surfaces
Cotton or polyester batting in plastic or muslin bags	Loose cotton	Easily snags brittle materials; can transfer lint to object
	Excelsior	Acidic
	Vermiculite	Generates dust difficult to remove from object; health hazard to museum worker
	Bubble-pak, air-cap	May contain poly-vinylidene chloride (see plastics section)

RECOMMENDED STORAGE MATERIALS

USE	DO NOT USE	WHY NOT
Plastic Foams		
Ethafoam 220® (manufactured by DOW); polyethylene closed-cell foam (<u>white</u> only)	Blue Ethafoam (fire retardant)	Fire retardant additives can migrate to materials.
	Pink Ethafoam (anti-static)	Introduced conductor in foam absorbs water from air and can become soapy
Microfoam® (manufactured by Amatek); low density, closed cell polypropylene	Any chlorinated or nitrated plastic (e.g., PVC-Polyvinyl chloride)	Outgases hydrogen chloride; can produce hydrochloric acid
Sentinel® Foam (manufactured by Packaging Products); polyethylene		
Extruded polystyrene (e.g., Foamular®, manufactured by Fomeboards Co.)	Polyurethane plastics, sheet and foam	Unstable; danger of off-gassing harmful products
Plastozote® (manufactured by Bakelite Xylonite, Ltd.); polyethylene closed-cell foam	Ethylene vinyl/acetate (EVA)	More elastic and rubbery than polyethylene; can cause yellow staining
Volara®, (manufactured by Voltek Co.); Cross-linked polyethylene foam		
Plastic Sheets:		
Mylar® (manufactured by DuPont); polyethylene terephthalate clear polyester	Saran-Wrap®, (e.g., polyvinylidene chloride)	Unstable, chlorinated plastic

RECOMMENDED STORAGE MATERIALS

USE	DO NOT USE	WHY NOT
Plastic Sheets (cont.)		
Film-O-Wrap 7750® (manufactured by Bell Fiber Products Corporation); clear polyester and fluoro-carbon laminate Scotchpak® (manu-factured by 3M Company); clear polyester/polyolefin laminate)	Cellophane	Acidic by-products due to sulphuric acid used in manufacturing process.
Boards:		
Archival corrugated board Acid-free Fome-Cor® (manufactured by Monsanto); extruded polystyrene core covered with acid-free paper Art-Cor® (manufac-tured by Monsanto); extruded polystyrene with polystyrene skin Honeycomb boards e.g., Tycore®, manufactured by Archivart) acid-free rigid paperboard; Hexcel Honeycomb®, manufactured by Hexcel Co.; aluminum-board.	Regular cardboard	Acidic

RECOMMENDED STORAGE MATERIALS

USE	DO NOT USE	WHY NOT
Boards (cont.)		
Fluted polypropylene boards (e.g., Cor-X®, manufactured by Fomeboards Co.; Coro-plast®, manufactured by Coroplast Inc.) Double-walled polycarbonate (e.g., Lexan Thermoclear®, manufactured by Cadillac Plastics)		
Microclimate:		
Silica gel grade 03, mesh size 3-8 (Source: laboratory and chemical supply companies) Silica gel RD03® (manufactured by W.R. Grace & Co., Davison Chemical Division) Art Sorb®, gel beads and unpregnated sheets (manufactured by Fuji-Davison Co.) Gore-Tex® silica tiles (manufactured by W. L. Gore & Associates) Humidity indicator cards (order from the Curatorial Services Division)		

RECOMMENDED STORAGE MATERIALS

USE	DO NOT USE	WHY NOT
Tape:		
Water-activated paper and linen tape	Pressure sensitive tapes; masking, strapping, duct and electrician's tape	The adhesive degrades and the carrier peels off leaving residues and stains
Cotton or polyester twill tape	Rubber bands	Rubber degrades and sticks to surface
Fabrics:		
Silk Crepeline (Talas; Conservation Materials, Ltd.) Polyester Stabiltex (Talas) Reemay 2014 (Talas); non-woven polyester fabric		

G. SELECTED BIBLIOGRAPHY

Adamson, Helen
1979 "Storage of Archaeological Material: The Problems." _Museum Archaeologist_ 3:3-9.

Christenson, Andrew L.
1979 "Cultural Resource Management; the Role of Museums in Cultural Resource Management". _American Antiquity_ 44(1):161-163.

Dowman, Elizabeth A.
1970 _Conservation in Field Archaeology_. London: Methuen and Co.

Ford, Richard I.
1980 "A Three-Part System for Storage of Archeological Collections." _Curator_ 23(1):55-62. New York: American Museum of Natural History.

Hodges, H. W. M.
1975 "Problems and Ethics of the Restoration of Pottery." _Conservation in Archaeology and the Applied Arts_, Contributions to the Stockholm Congress, IIC, June 2-6, pp. 37-38.

Keene, S. (ed)
1980 _Conservation Archaeology and Museums_. UK Institute for Conservation, Occasional Papers No. 10.

Leigh, David
1982 "The Selection, Conservation and Storage of Archaeological Finds." _Museums Journal_ 82(2):115-116.

Majewski, Lawrence
1972 "On Conservation: Archaeological Sites." _Museum News_ 51(3):11-12.

Moyer, Curt
1986 "Archaeological Conservation Forum: This is not a Fixit Shop!" _Society for Historical Archaeology Newsletter_. 19(2):33-36.

Pye, Elizabeth
1986 "Conservation and Storage: Archaeological Material." _Manual of Curatorship_, 203-238. London: Butterworths.

Sease, Catherine
1987 _A Conservation Manual for the Field Archeologist_ Archeological Research Tools, Vol. 4, University of California, Los Angeles: Institute of Archeology.

Singley, Katherine R.
1981 "Caring for Artifacts after Excavation-Some Advice for Archaeologists." Historical Archaeology 15(1):36-48.

Stanley Price, Nicholas (Ed.)
1984 Conservation on Archaeological Excavations. Rome: ICCROM.

United Kingdom Institute for Conservation
1983 "Excavated Artifacts for Publication." Conservation Guidelines No. 1.

1983 "Packaging and Storage of Freshly Excavated Artifacts from Archaeological Sites." Conservation Guidelines No. 2.

1984 "Environmental Standards for the Permanent Storage of Excavated Material from Archaeological Sites." Conservation Guidelines No. 3.

Watkinson, David E. (Ed.)
1987 First Aid for Finds. UKIC Archaeology Section/RESCUE, London: The British Archaeological Trust.

APPENDIX J. CURATORIAL CARE OF PAPER OBJECTS

APPENDIX J. CURATORIAL CARE OF PAPER OBJECTS

A. INTRODUCTION

Handmade from naturally occurring plant fibers in a labor intensive process, paper was for centuries a precious commodity, expensive and scarce. Paper is popularly believed to have been invented in China, some 2,000 years ago. In ancient times, it was exported throughout the known world, although the papermaking process was a closely guarded secret. In the late Middle Ages, papermaking technology was imported into Europe.

The first American papermill was established in the late seventeenth century. By the early nineteenth century, there were almost two hundred mills making handmade paper in the United States. Despite many innovations, paper continued to be made by hand from rag fibers. While the quality of the finished paper varied enormously, even the lowest quality rag paper was expensive.

Advances in papermaking technology during the nineteenth century Industrial Revolution made possible the production of abundant and inexpensive paper for the first time in history. In the United States, handmaking processes were replaced by mass production of machine-made paper. The increased demand for fibers was met by making pulp from wood. The cheapest paper, made entirely of groundwood pulp, was used mainly for printing newspapers and broadsides, and in other commercial applications. While some of this paper survives in archives, it is usually in very poor condition, because of its inherent chemical instability.

Higher quality machine-made paper included at least some rag fiber, and was used in finer applications (e.g., stationery, books, and artistic works). Some applications, such as photography required a high grade paper made entirely of rag fibers, and such paper continued to be available. American machine-made imitations of handmade paper were marketed, and true handmade paper continued to be imported from Europe. True handmade paper was not produced commercially in the United States until the technology was revived by papermaking artists in the mid-twentieth century.

Along with these advances in the technology of papermaking came advances in printing, photography, and reprography. Historic collections may contain a variety of papers, used in many ways to produce records and other paper objects. Objects predating the mid-nineteenth century are fairly uniform in character. Paper objects produced after this period vary widely in structure and composition, and, thus, in permanence. The book <u>Papermaking</u> by Dard Hunter, listed in Section E of this Appendix, provides an excellent history of the technology of papermaking. Marjorie Cohn discusses how papers are made and used, and how this affects the object's appearance in <u>Wash and Gouache</u>, "Paper and Paper Preparation", pp. 16-26. This book also is listed in Section E.

This appendix discusses the curatorial care of a range of paper objects, from small to oversize, including archival and manuscript materials (e.g., documents, letters), prints and drawings, maps and architectural records.

This appendix does not address the care of photographs and books. Paper materials are fragile and most susceptible to deterioration caused by agents of deterioration and by inherent defects. Preventive care is critical to preserving paper collections. Even papers considered durable are easily damaged by poor environment, improper storage and exhibit techniques, and careless handling. Once the object is stained, embrittled, torn, or creased, it becomes all the more fragile. Conservation treatment (e.g., repair) is expensive in staff time, workspace and the cost of materials, and is often not justifiable for historic objects which may have little monetary value. Even when a paper object can be treated by a conservator, its historic structure and appearance are usually altered in the treatment process.

B. THE NATURE OF PAPER

1. Structure of Paper

The primary component of paper is cellulose. The structure of most kinds of paper is similar, regardless of the fiber source. A sheet of paper is actually a web of fibers, held together by their physical entanglement, by very weak chemical bonds between the fibers, and by the weak adhesive power of the "sizing", a substance often added to the paper as it is made. In addition to sizing, the paper may be permeated with a "filler", such as clay. Sizings and fillers are used to control the properties of the paper. For example, they make paper less absorbent and smoother to facilitate printing, as with heavy, shiny art book paper and glossy magazine paper.

The paper itself is usually only part of the object. It is often referred to as the "support." Equally important are the media used on the paper. A collection of correspondence, for example, may include media as diverse as old handmixed inks, modern ballpoint pen inks, graphite, colored pencils, and wax crayons. These are examples of hand-applied media.

Media applied by hand can be distinguished from media applied mechanically or reprographically. Mechanical processes of reproduction include letterpress, steel engraving, and lithography, all of which use the medium of printer's ink. More modern reprographic processes such as mimeography and xerography use a wide variety of inks, pigments and binders.

A variety of fibers have been used historically to make paper. In the western hemisphere, plant fibers such as cotton and flax were used to make paper by hand as early as the 14th century A.D. This labor-intensive process produced a strong and durable paper that was also very expensive. As the need for paper exceeded the supply of virgin fibers, recycled plant fibers obtained from cotton and linen rags were also used to make paper. The term "rag" paper means any paper made solely of cotton or linen fibers, whether the source was the plant or cloth made from the plant. Paper objects dating from before the mid-nineteenth century almost always are made of handmade rag paper.

Beginning in the mid-nineteenth century, the quality of paper declined. The technology was developed to extract the fiber from wood, making paper inexpensive and abundant. The cheapest type of fiber for papermaking pulps is obtained by simply grinding up lumber. Paper (e.g., newsprint) made by this process is known as "groundwood" paper. Along with the cellulose fibers, groundwood paper contains the other materials which occur naturally in wood (e.g., lignin). Lignin, a plant protein, is inherently unstable and generates acid as it deteriorates. Cellulose has a chain-like structure that is very vulnerable to attack by acid. Acid generated by the deteriorating lignin cuts the cellulose chains, making the fibers shorter and

weakening the paper. Groundwood paper begins to deteriorate as soon as it is made. Other plants (e.g., hemp and manila) are also used for paper fibers. Papers made with these fibers have similar problems caused by naturally occurring acidic properties.

Another type of paper is made from groundwood pulp that is chemically purified to remove all but the cellulose fibers. This "chemical woodpulp" paper is not as strong as rag paper because its fibers are much shorter. However, it is not self-destructive like the groundwood paper because the acid-generating properties have been removed.

The quality of paper is determined by its durability and permanence. The degree to which paper retains its original strength during its history of use is called <u>durability</u>. The degree to which paper remains chemically stable and resists deterioration from inherent impurities or environmental agents of deterioration is called <u>permanence</u>.

2. <u>Problems with Paper</u>

Every paper object is a combination of fibers, adhesives, and media. If any of these elements are unstable, the paper object will be inherently unstable and will deteriorate, as illustrated by the following examples:

a. <u>A manuscript</u> (iron gall ink on rag paper sized with gelatin)

The gelatin size originally served to make the paper repel the watery ink, preventing the ink from feathering and bleeding into the paper as it was applied. The gelatin size has degraded and any water applied now will be quickly absorbed by the paper.

The rag paper itself is still strong and durable, except where the iron gall ink has been applied. The ink contains sulphuric acid that has damaged the paper. Overtime, the ink has eaten into the paper, most severely where it was thickly applied. The iron gall ink has almost certainly faded from its original black to its present brown color.

b. <u>A pencil drawing on tracing paper</u>

The paper was made transparent by impregnating it with resin. Over the years, the resin has oxidized, darkened, and made the paper very brittle. The image, made with graphite pencil, is chemically stable, but may be mechanically damaged or lost by abrading, rubbing, or smudging.

c. <u>A newspaper</u> (printer's ink on groundwood paper)

Groundwood paper becomes acidic as it ages. This acid has broken down the fibers so completely that the paper now shatters when

flexed. The printer's ink is stable, and does not appear to have faded. The oil in the ink may be slightly acidic.

Even when all the paper object's elements are stable, if they do not respond uniformly to environmental changes the object will be inherently unstable in some environments. The following examples illustrate deterioration caused by internal qualities, a condition called "inherent vice."

d. An electrofax copy

The paper is chemical woodpulp, free of organic acids. The paper's coating is made of zinc oxide and starch, both inert. The image is made of carbon black, a lightfast pigment, heat-fused onto the paper surface. Taken separately, each element is stable; however, since the elements do not behave uniformly, the object is inherently unstable. When damp, the object is extremely unstable. The incompatibility results from different physical responses to water. The paper expands, but the zinc oxide coating does not, causing the coating to separate from the paper. This effect is most obvious when water is sprayed onto the object, but may be subtle when it results from exposure to water in the form of high relative humidity.

e. An ink drawing on paper with a paper patch

The ink is a lightfast and waterproof India ink. The paper used for both the drawing and the patch is a rag paper, sized with gelatin. The incompatibility of the drawing and patch results from the way the patch was applied. Paper expands and contracts as the relative humidity rises and falls, usually more so in one direction than in the other. The grain of the large piece of paper is parallel to its long dimension, and the paper tends to expand and contract least in this dimension. The grain of the patch and the grain of the larger piece of paper are not aligned, so the patch tends to expand and contract in a different direction. Over the years, small differences add up, so that now, large cockles radiate from the patch. These cockles prevent the drawing from lying flat. If the drawing is forced flat by weighting it, folds and creases will form at the cockles. Paper tends to be abraded from the highest surfaces of folds and creases, further damaging the object.

The deterioration of paper may result from internal causes (e.g., poor quality pulp, bleaching residues, unstable sizings, and acidic inks). In addition to these built-in weaknesses, external agents (e.g., fluctuating temperatures, high and fluctuating relative humidity, light, air pollution, pests, contact with acidic materials, careless handling, and natural disasters) may cause paper objects to deteriorate. Inherent weaknesses and external agents often reinforce each other to cause a vicious cycle of deterioration. It is useful

to think of deterioration as either chronic or acute. The distinction between chronic and acute deterioration is one of time rather than of cause.

Chronic deterioration occurs over a long period of time. It is caused by "inherent vice" (e.g., acidic properties in the structure or media) and by long-term exposure to high relative humidity, high light levels, poor quality enclosure materials and improper storage equipment. Chronic deterioration sometimes goes unnoticed because it occurs gradually.

Acute deterioration is more immediate in its effects. Disasters (e.g., flood and fire) and biodeterioration (e.g., insect infestations or rampant mold growth) cause acute deterioration. Mechanical damage to paper objects from folding, tearing, and abrasion can cause acute deterioration, although the gradual wear-and-tear on collections caused by poor handling practices is considered chronic.

Acute deterioration such as the accidental tearing of a paper object might seem to have been caused by an isolated set of circumstances. Answer the following questions:

- What chronic conditions may have contributed to this event?

- Are objects being damaged because of these conditions, perhaps with results which are less noticeable than this tear?

Note: The conditions causing chronic deterioration may be due to a combination of factors: (1) inadequate housing so that the object is not physically protected from damage during handling, and (2) poor storage conditions (e.g., high temperature and low relative humidity) so that the object has become embrittled, and therefore, more susceptible to damage.

C. AGENTS OF DETERIORATION

1. Environment

As discussed in Chapter 4, there are four main agents within the environment that cause deterioration: relative humidity, temperature, light, and air pollution. At unacceptable levels, each of these agents alone can cause or hasten the deterioration of paper objects. Their combined effects are even more damaging. Paper objects are also vulnerable to biological deterioration through the actions of molds, insects, and rodents. Refer to Chapter 5 for a discussion of biological infestations.

a. Temperature

Most of the chemical reactions by which paper objects deteriorate proceed twice as fast with each 5.6°C (10°F) increase in temperature. For this reason, paper, especially "groundwood" papers, should not be exposed to high temperatures. High temperatures cause brittleness.

Different materials can respond differently to changes in temperature. Some of the materials found in paper objects, such as gelatin adhesives, are very reactive to changes in temperature, shrinking and relaxing as temperature rises and falls, while other materials are less reactive. Changes in temperature can thus cause damage within the object.

Paper objects should be stored at a constant temperature, theoretically the colder the better. However, when the objects are accessed, they will need to be brought to room temperature. A change from 12.8°C (55°F) to 18.3°C (65°F), if it were to occur too rapidly, would cause condensation on the objects. Practical considerations suggest a temperature of 15.6-21.1°C (60°-70°F).

b. Relative Humidity

Cellulose is hygroscopic. It has a physical attraction for water, making relative humidity (RH) one of the critical factors in the paper object's environment. Paper contains water both within its chemical structure and bound loosely to its surface. The water in paper is in equilibrium with the water in the air. As the relative humidity drops, paper gives up water to maintain this equilibrium. It contracts physically, becoming smaller as it loses water. Paper will give up the loosely bound surface water first. It will regain this water if the relative humidity rises, expanding again as it takes in the water. Once the surface water is gone, the paper is forced to give up structural water. This water cannot be replaced, leaving the paper permanently dessicated. Dessication can cause embrittlement. Some media, such as inks and gum-based watercolors, are similarly responsive to changes in RH and can become dessicated.

Papers are more or less responsive to moisture depending on their composition. Thin papers such as tracing papers and onion skin typing papers are especially responsive to changes in relative humidity, expanding dramatically in humid air and contracting in dry air. Thick, heavily sized papers such as ledger papers and paperboards are more impervious but still respond on a smaller scale to changes in RH.

In a temperate climate the optimum relative humidity would be about 47%. However, other opposing requirements, such as the needs of other objects of differing materials, the ambient RH for the geographic region, and facility limitations, may lead to a compromise at another level within the range 45-55%.

Paper requires a certain amount of water to be flexible. At an RH level below 40%, paper becomes less flexible and more susceptible to damage from handling. Below 40% RH rolled papers are more easily torn during unrolling, pamphlets and stapled sets of sheets are more easily broken when the paper is flexed; thick paperboards tend to break when flexed.

High relative humidity levels (i.e., above 68% RH) can contribute to paper deterioration in several ways. High RH encourages <u>infestations of insects</u>, that physically consume parts of paper objects and leave damaging waste products on the surface. The most familiar problem resulting from high RH is <u>mold growth</u>. Mold feeds on the sizings, coatings and adhesives found in paper objects. It can leave the paper structurally weakened, chemically altered, and stained. Severe mold growth can leave records illegible and so structurally damaged that the sheets of paper either fall to pieces when handled or are stuck together in a massive block.

A more subtle kind of damage from relative humidity can occur within paper objects. Rapid fluctuations outside of the acceptable ±3% RH are deleterious because they cause the paper objects to continuously expand and contract. The greater the range of fluctuation, the greater the stress caused to the object. Such continuous stress is especially damaging to objects that are composed of more than one material.

Materials respond to RH depending on their attraction to water. As noted before, paper expands when the RH level rises and contracts when the RH level falls. If a paper object is held tight by a binding, adhesive or fastener, for example, it may be damaged where it is constrained from expanding and contracting. If the object is a combination of paper and another material, it will be inherently unstable if the other material responds differently to changes in RH. An example is a paper object mounted on cardboard. Over the years, the paper has responded to changes in RH by expanding and contracting much more than the

cardboard mount. The surface of the paper now has a cockled or buckled texture resulting from its expansion being hindered where it is attached to its mount.

c. Light

The effect of light on paper objects is cumulative and irreversible. Both visible light and ultraviolet radiation cause serious damage to paper objects. Some papers and media are more sensitive to damage by light than others. However, no papers of historic value should be displayed long term, or at light levels higher than 50 lux. <u>Exhibit duration should never exceed six months</u>.

While all paper objects are sensitive to light, the degree of the object's light-sensitivity depends on the nature of the materials and media. For example, "groundwood" paper quickly turns brown and brittle, its chemical deterioration from inherent-vice being accelerated by exposure to light. Rag fibers are fairly stable, but even rag papers may be stained or bleached by exposure to light, depending on the properties of the sizing.

Most colored materials found in paper objects are made with dyes, and fade quickly when exposed to light. Examples are colored papers, colored pencils and crayons, ballpoint and felt-tip pen inks. Watercolors are especially sensitive because the medium contains little dye or pigment. Some paper objects on which the image has been photographically produced, such as blueprints and sunprints, fade quickly when exposed to light.

If a paper object has been uniformly exposed to light, it has probably faded or discolored uniformly, making it difficult to tell that a change has taken place. If the object has been partially covered with a mat, sometimes you can tell the paper or the media has been altered by comparing the area under the mat where the paper was protected from light to the area exposed to light by the mat window. However, the comparison may be complicated if the mat is of poor quality materials and has itself stained and contributed to the deterioration of the object.

In general, design media which are pure minerals such as graphite, white chalk, and red chalk, and media based on pure carbon such as charcoal, India ink, and most black printing inks, are fairly stable in light. Objects made with these stable media are more likely to be limited by the paper's sensitivity to light. For example, a white chalk drawing on blue paper: in this case, the white chalk is not sensitive to light, but the blue paper is sensitive. Only a very low light level and a short period of exposure is acceptable for this object. If the paper and the media are relatively stable in light, the object can be exhibited at the maximum light levels and for the maximum time allowed for paper objects. For example, this would be appropriate for most objects made with black printer's ink on rag paper (e.g., an 18th

century broadside). Such items might appropriately be displayed at maximum light level for maximum time period allowed for paper objects, (i.e. six months at visible light levels of 50 lux [5 footcandles]).

d. Gaseous Pollutants and Dust

Gaseous pollutants (e.g., oxides of nitrogen and sulfur) transformed into acids, are very damaging agents to paper objects. "Groundwood" papers are especially vulnerable. Formaldehyde, given off by plywood, pressed wood, some foams and other synthetic materials, cause conditions that lead to serious deterioration of paper. Gaseous pollutants are especially damaging when the relative humidity is high and the object is exposed to high levels of light.

The affect of dust on paper objects depends on the composition of the dust. Sharp particles, such as sand and sea salt, abrade paper and design media as they are dragged across the object's surface. Oily particles from engine exhaust, cigarette or cooking smoke may become embedded in the paper fibers, soiling the paper and providing food for mold and insects. If the dust is acidic or contains metal particles, it accelerates the chemical deterioration of the paper. Because of paper's fibrous and absorbent nature, dust contamination can cause irreversible deterioration. Surface dust usually can be reduced, but rarely can be removed completely.

2. <u>Acidity</u>

Acidity is the primary cause of paper deterioration. It causes paper to become weak, brittle, and stained. The sources of acid in paper include:

a. Materials used in the papermaking process, especially from 1850 to the present (e.g., alum-rosin sizing, groundwood pulp)

b. Residual bleaching chemicals, inks (e.g., iron gall ink), and air pollutants (e.g., sulfur dioxide)

c. Direct contact with acidic materials (e.g., file folders, adhesives, mat boards, unsurfaced wooden backings, unstable plastic sheeting)

d. Exposure to acidic vapors from a closed document box or wooden file drawer

It is important to note that acid migrates. The ability for acid to move from an acidic material to an object of reduced or no acid is called "acid migration." The rate of acid migration is dependent on the moisture present; it is increased in humid conditions and slowed in dry conditions.

The concentration of acid is measured on the pH Scale - an arbitrary scale with numbers ranging from 0 to 14. The number 7.0 on this scale indicates that the pH of the material is neutral. All numbers below 7.0 indicate an increasingly acidic condition. All numbers above 7.0 indicate an increasingly basic or alkaline condition. A high alkaline condition also can cause paper to deteriorate. The pH Scale is logarithmic (e.g., a paper object with a pH 3.0 contains 10 times as much acid as an object with a pH 4.0 and 100 times as much acid as paper with a pH 5.0). <u>The pH of most paper objects found in collections is in the acidic range below 5.0</u>. A more desirable pH range is 6.5 to 8.5.

3. <u>Molds and Pests</u>

A complete description of the characteristics of the molds and pests listed below are included in Chapter 5, Section B of this handbook.

a. Molds

Molds grow on any material that provides moisture and organic nutrients. Molds literally destroy the sizing in paper and very often cause patches of staining or discoloration. Molds thrive in damp environments (e.g., a relative humidity level of 65% or higher), especially with still air.

b. Insects and Rodents

The most destructive pests for paper objects are bookworms (larval stage of the drugstore beetle and cigarette beetle), silverfish, cockroaches, booklice, common fly, and the house mouse. Powder in small round holes is an indication of an active infestation of bookworms. Silverfish eat completely or partially through paper. Look for their damage particularly in undesigned areas of prints and watercolors. Cockroach feeding on paper leaves ragged edges of paper and cardboard. Damage by this insect also can be caused by excrement. Booklice feed on mold. While not causing direct harm to paper objects, they are an excellent indicator of a mold infestation.

The common fly does not feed on paper or adhesives. However, this insect seeks shelter in books or framed paper objects. It leaves acidic excrements that are corrosive to paper.

The house mouse can damage or destroy large collections of unprotected papers. Look for their nests by observing the concentration of droppings.

D. PREVENTIVE CONSERVATION

A program of basic preventive maintenance carried out by park curatorial staff is the most cost effective approach to the care of large paper collections. A preventive conservation program includes the following elements:

- Performing non-interventive treatments
- Monitoring and controlling the environment
- Using appropriate housing and storage techniques
- Practicing conscientious handling and exhibit techniques
- Assessing the condition of the collection

1. Non-Interventive Preservation Treatments

The first step in preventive conservation for paper objects is non-interventive maintenance that can be performed by park curatorial staff. This step, critical to stabilizing an object's condition, includes removing any foreign materials that are damaging or jeopardizing the object (if removing them will not in itself damage the object) and placing the object in a safe environment. The goal is to slow deterioration as much as possible, while taking very limited action. Whether it is the only step taken to improve the object's condition, or merely the first step in a program, stabilization is one of the most effective means of preservation. By practicing this level of preventive conservation, park curatorial staff will improve the conditions for the maximum number of objects at the least cost in time and materials.

In organic archival collections, the order and relationship of the papers often is important and must be preserved by the curatorial staff. This principle is discussed in the NPS Museum Handbook, Part II, Museum Records. In such collections the staff must consider the intellectual arrangement of the materials as well as preservation concerns when preparing papers for storage.

Examples of non-interventive stabilizing measures are discussed below. Many of the materials needed for these measures will be described later in this chapter.

a. Examining a box of documents to identify the mediums and note the condition of objects (e.g., insect damage, surface dirt, staining, yellowing, tears, embrittlement).

b. Papers that have been stored exposed for some times often are covered with a layer of dust. Curatorial staff can use a soft artist's or cosmetic brush to gently remove the loose dust before handling and storage. Any more in-depth cleaning should generally be left to a conservator.

c. Archival papers are generally removed from their soiled or acidic folders for long-term storage. File names and other labels are carefully copied onto new, acid-free folders; the old folders are

retained if they contain any annotations that cannot be transcribed, such as sketches. The papers are transferred to the new folders. Take care not to overfill the folders. The more fragile or valuable the papers, the fewer should be stored together in one folder.

d. Store folders of documents horizontally or parallel to the shelf surface whenever possible, especially if the documents are fragile or brittle. Documents placed in flip top document boxes or print boxes can be laid flat on shelves to fully support the papers. See Section 4 "Storage Enclosures and Supplies" below for a discussion of storage box types.

   Documents that are in good to fair condition and without high intrinsic value can be stored vertically, e.g., in records storage boxes (see below). If documents are foldered and stored vertically, ensure that the folders are fully supported by filling the box with loosely packed folders, or by filling extra spaces with crumpled acid-free tissue, or cardboard inserts. Do not allow the folders to slump or curl in the box, or pack the folders too tightly to handle gently.

e. When archival files are placed in permanent storage, the original fasteners, including staples, paper clips, string ties, rubber bands, brads, and straight pins, should usually be removed. This is especially important when metal fasteners are corroded, when the attachments distort the shape of the documents, or when research use can result in damage, such as in producing photocopies. Fasteners can usually be removed by the park curatorial staff, although fasteners should always be left in place if removing them will damage the documents or their historical integrity. Consult NPS Conserve O Gram 21/4, "Removing Original Fasteners from Archival Documents," before removing any original fasteners from archival documents. The Conserve O Gram describes special techniques for removing rusted fasteners and protecting fragile paper during removal. It cautions never to use staple removers.

   If fasteners are removed, it is important to maintain the order and relationship of the documents. Unattached documents in files can become disordered by researchers. In small collections of valuable documents, such as manuscript collections, each single-sheet or multi-page document can be stored without fasteners in its own acid-free folder. When this is not feasible, archivists and archival conservators propose several methods for maintaining the arrangement of previously attached groups of sheets. Different methods will be found appropriate in different situations. See NPS Conserve O Gram 21/5, "Attachments for Multi-Page Historic Documents" for a discussion of these methods.

f. Removing the deteriorated rubber band from around a roll of drawings, and placing the roll of drawings in an acid-free tube. This process halts damage to the paper from the sulfur-containing

rubber band, and protects the drawings from dust and from being torn at their exposed edges. Consult NPS Conserve O Gram 21/4, which discusses removal of ties and rubber bands, including those that have deteriorated and stuck to the paper. If the sticky residue from rubber bands does not readily come off, the paper will need to be interleaved or covered with silicone release paper to keep it from sticking to other papers or storage containers.

g. Removing a faded blueprint from a sunny exhibit wall, and placing it in a polyester folder in a dark storage drawer. This action arrests the fading and prevents further exposure to light. The polyester folder is chemically inert, and protects the paper from being torn during handling.

h. Removing a stained print from its acidic mat, and placing it in an acid-free folder. This removes the foreign source of acidity. If the print is glued to the mat, or if the mat is glued to the backboard, the print should not be removed. Removing materials that are adhered to the object goes beyond stabilization. Note this condition for future treatment by a paper conservator.

i. Some dissimilar objects are best separated from other materials or relocated, even in organic collections. If objects are moved, the staff must note both the object's orginal location and the new, so that the relationship of the documents remains clear. For example, photographic negatives are often removed from a series of papers and stored with other negatives in individual sleeves. If this is done, complete and insert a "Separation Sheet" such as the form in Figure J.1 in place of the negative.

Photographic prints in organic collections can be sleeved and left in place, or a photocopy of the print can be inserted in its place and the photo relocated to a print collection, again, in its own sleeve. Note on both the photo enclosure and the photocopy the print's former and new location.

A newspaper clipping enclosed with a letter must be sleeved or interleaved if left in place, to ensure that its acidity is not transferred to adjacent papers. The clipping can also be photocopied and removed for storage elsewhere. Some archives do not retain unannotated original clippings because their high acidity makes them difficult to preserve; this is a curatorial decision.

In this way incompatible materials can be isolated by barriers (such as sleeves or interleaving sheets), or by planned rearrangement, for preservation reasons, while still preserving the papers' relationships. In collections not considered to have a significant order, such as some manuscript collections, the arrangement can be altered to best suit the collection's preservation needs.

j. Papers that are folded, such as correspondence, should usually be carefully unfolded for storage, provided they are supple enough to be opened safely. Flat storage is generally preferred for rolled papers small enough to fit in map case drawers. Papers that resist unfolding or unrolling can sometimes be opened safely and flattened for storage by controlled exposure to high relative humidity. NPS Conserve O Gram 13/4 describes procedures for humidification and flattening. Note: This procedure must be carried out with care as it is more interventive than other procedures described here. If the papers are damaged or embrittled and in danger of cracking, request the assistance of a paper conservator before attempting to open them.

NATIONAL PARK SERVICE
SEPARATION SHEET ______________ **ARCHIVES**
(Park Acronym)

Type of Item (map, newspaper, artifact, etc.)

Description of Item

Item Originally Filed (specific location)

Item Now Filed (specific locations)

Separated By	**Separation Date**

Figure J.1. A Sample Separation Sheet[1]

2. <u>Museum Storage Environment</u>

a. Temperature

The optimum temperature varies depending on the materials and physical format of the object. The range 60°-70°F is acceptable for most objects found in paper collections. If a variety of objects are to be housed in one environment, maintaining levels within this range is recommended.

b. Relative Humidity

The acceptable level of relative humidity also depends on the materials and physical format of the object. A stable relative humidity within the range of 45-55% RH is acceptable for most objects in paper collections.

While biological infestation is encouraged by high RH, it cannot be controlled solely by maintaining an acceptable relative humidity level. Appropriate housekeeping is also critical to the control of pests. Refer to Chapter 5 of this handbook for guidance on pest control.

If there are museum storage spaces with separate environmental controls, the particular needs of the objects may be matched to the storage environments. For example, rolled or bound objects, which require flexing in handling, are more safely handled at a higher RH than at a lower RH within the acceptable range. Objects that will not be handled can be safely stored in areas with lower RH.

c. Light

The standard for exhibition of paper objects limits the exposure to six months at visible light levels of 50 lux (5 footcandles) or less for most objects (e.g., black-and-white prints, pencil drawings on rag paper, and watercolors). The UV radiation level must not exceed 75 microwatts/lumen in exhibit areas. During the exhibit period, turn lights off when no one is in the exhibit area for a sustained period. The standard for visible light in museum storage spaces is darkness when the space is unoccupied.

d. Gaseous Pollutants and Dust

Where practical, protect paper collections by housing storage spaces as far as possible from loading docks, lots, photocopying machines, and other ongoing sources of pollutants. Protect objects from predictable exposures. For example, remove paper objects before museum storage spaces are repainted. Do not place paper objects in painted exhibit cases until the paint has thoroughly dried.

Control dust by an appropriate ventilation system, filtering particulates from the air before they settle on surfaces. Implement good housekeeping practices (e.g., dusting and vacuuming). In removing dust that has settled, it is critical to actually capture the dust and not just redistribute it.

3. Pests

Establish an Integrated Pest Management (IPM) Program in spaces that house museum collections. Refer to Chapter 5 for guidance on a museum IPM program. Inspect all incoming collections for evidence of pest activity. Take the time to look at each object and its enclosure material for any signs of active insect or mold infestation. Periodically inspect the museum space and adjacent spaces and drawers, shelves, and boxes. Practice good housekeeping. If pest activity is discovered in the space, but not in the collection, increase the monitoring phase of the IPM program. If infested objects are discovered, immediately isolate them from the museum collection and take the action outlined in Chapter 5, Section D.

4. Storage Enclosures and Supplies

Within the storage space environment, the paper object's most immediate environment is created by the enclosures in which it is housed. As stated in Chapter 7, the purpose of the housing system is two-fold: it facilitates the physical organization of the collection and it provides an environment that is as clean and safe, chemically and physically, as possible.

Appropriate housing is especially important for paper objects if environmental control measures are less than ideal. The same materials used to make paper are used to make acid-free folders and boxes. As previously described, cellulosic materials respond to changes in the environment: taking in moisture when RH rises and releasing moisture when RH drops. Housing enclosures like folders and boxes help to protect the enclosed objects to some extent from abrupt changes in RH. In addition, closed boxes and drawers help to protect the objects from dust and other particulates.

Depending on the variety of paper objects within the collection, the housing system can include a variety of enclosures. Few parks have the luxury of starting from scratch to design a state-of-the-art system tailored to their collection. Sometimes curatorial staff is limited to commercially available products compatible with historic furniture that may or may not have artifactual value itself. However, there are basic principles to guide a park staff's efforts in providing the best housing and storage possible. These principles focus on supply materials, supply formats, and supply sizes.

a. Supply Materials

Because an enclosure is in prolonged and direct contact with the object, it is critical that the enclosure be made of materials that will not damage the object. To ensure this requirement, housing enclosures are usually required to meet certain specifications.

Specifications and methods of testing materials may change over time. At the National Archives and the Library of Congress, staff scientists and conservators continue to test and develop standards for materials to be used near paper objects. The Conservation Analytical Laboratory of the Smithsonian Institution also has research facilities and a technical information service that provides information on request. The Curatorial Services Division, WASO, acts as a Servicewide clearinghouse on information about appropriate museum collections storage materials. Refer to the NPS Tools of the Trade for a list of types of and sources for enclosures used to house paper objects.

In general, materials used to make enclosures must be non-abrasive and buffered (alkaline) or chemically neutral. Specific requirements have been developed for paper and plastic, since these materials are most commonly used to make enclosures for paper objects.

1) Paper

All paper products used to make housing enclosures, (e.g., sleeves, boxes, folders), must be free of acid, lignin, alum, and sulfur. Parks that order enclosures directly from a vendor should include this specification in the purchase order. Acidity is the most easily detected. Acidity is measured in units of pH ranging from 0 (very acidic) through 7 (neutral) to 14 (very alkaline). To test archival supplies for acidity, refer to NPS Conserve O Gram 13/3, "Determining the pH of Paper." The paper's pH can be manipulated during manufacture by loading or "buffering" the paper with alkaline salts, usually calcium carbonate. Storage materials described as "buffered," are commonly expected to be in the pH 8.5 range. Alkaline salts act to neutralize acid, thereby protecting the paper from attack by acid in the environment. The amount of protection depends on how much of the buffering salt is present and the acidicity level of the enclosure.

The pH indicator strips described in NPS Conserve O Gram 13/3 are manufactured by E. M. Science, 480 Democrat Road, Gibbstown, NJ 08027, and are available from most archival suppliers. An initial neutral (pH 7) or alkaline pH is no guarantee that the paper will not become acidic in the future. Some storage envelopes sold many years ago as "archival quality acid-free" are now very acidic. These enclosures were made of groundwood paper and then buffered to

achieve an initial high pH. As the paper has aged, the lignin has generated enough acid to deplete the alkaline buffer. Testing for lignin specifically, or more generally for groundwood, is advisable even if the paper is acceptable in pH, to ensure that the paper will not become acidic in time. A spot testing kit is available to test for acidity, alum, and groundwood. The "Tri-Test Paper Testing Kit" can be used without special training and is available from Applied Science Lab, Inc., P.O. Box 24329, Richmond, VA 23224.

Paper products made exclusively of cotton fibers are often described as "100% rag". Products may also be described as "lignin-free", and "pure alpha-cellulose". Alpha-cellulose is the type of fiber left after lignin is removed chemically from woodpulp. None of these products are expected to contain lignin, but all of them should be tested.

A positive alum test (using the Tri-Test Paper Testing Kit), indicates the use of alum-rosin sizing. Like lignin, alum-rosin sizing causes the paper to deteriorate as it ages. Sulfur may also be present. Particularly harmful to silver, sulfur is also damaging to paper. Enclosures testing positive for alum or for sulfur should not be used to house paper objects.

Buffered vs. Unbuffered Paper Products

Most acid-free paper products available today are described as either "buffered" (usually around pH 8.5) or "unbuffered" (neutral or pH 7). When they are described only as "acid-free" a more specific term must be requested. Each type is appropriate in specific circumstances, depending on its specific chemical characteristics and those of the objects to be housed.

Buffering can be expected to prolong the life of the enclosure itself in an acidic environment. As long as it is alkaline or neutral in pH, the enclosure will protect the object from the acidic environment to some extent. Contact with a buffered enclosure will not raise the pH of the enclosed object. It extends the life of the object by neutralizing acid breakdown products and will prevent the acidic object from contaminating others. For example, buffered tissue paper used to interleave paper objects extends the life of the papers in contact with it. It will have little effect on papers more than two pages away.

Certain objects such as blueprints, cyanotypes, sunprints and dye transfer prints are slightly acidic by nature, and are damaged if the pH of the objects is raised. These objects are adversely affected by alkaline conditions. Some water color pigments are also alkaline sensitive. Unbuffered (or

neutral) enclosures are therefore recommended for **blueprints, cyanotypes, sunprints, dye transfer prints, and water colors.** Buffered enclosures are generally acceptable for all other types of paper objects.

To date, large acid-free map folders and acid-free tubes are available only in buffered stock, unless neutral folders are custom ordered. Buffered folders may be lined with polyester film for objects requiring a neutral environment, such as blueprints, to prevent the object from contacting the buffered paper. A sheet of polyester film may also be used to cover the face of the object.

2) Plastic

All plastics used in housing enclosures for paper objects must be chemically inert. Acceptable plastics include pure polyesters, polyethylenes, and polystyrenes that are free of powders, coatings, plasticizers, and other additives.

Unacceptable plastics include all polyvinylchlorides, informally called "vinyl" and "PVC". This material is widely used commercially. It can be found on most 3-ring binders, many plastic page protectors and multi-pocket sheets, in albums. Polyvinylchloride is inherently unstable. As it deteriorates, it can soften and stick to objects, can cause objects to soften, ballpoint pen inks to bleed, and other kinds of damage.

Information on the exact composition of plastics should be available from the distributor. Unfortunately, testing incoming housing enclosures to confirm this information is more complicated with plastic than with paper. Precise identification can require burning and chemical tests. These tests should be done only by trained staff under controlled conditions and with the most conservative safety precautions.

Undesirable chlorine-containing polymers, such as polyvinylchlorides, can, however, be quite simply identified using the Beilstein test. A copper wire, (e.g., 12 or 14 gauge) is held in the blue section of a gas or alcohol flame until it is red hot and the flame burns clear. The hot wire (cooled until it is no longer red hot) is then touched to the polymer in an inconspicuous place, since it will mar the plastic. Immediately return the wire to the flame. If the flame produces a green color, chlorine is present. (See CCI Note 17/1, "The Beilstein Test", for further information.)

More general identification of obviously unacceptable plastics can be accomplished by visual inspection and comparison to known examples. You can compile your own set of samples: most distributors will supply a sample housing enclosure on request. A readymade kit of labelled samples,

such as "Caveman Chemistry of Plastics", can also be very useful for comparison to sample enclosures. This kit includes samples and descriptions of various plastics, and is available for a nominal fee from Taylor Made Company, P.O. Box 406, Lima, PA 19037.

Polyester film is the plastic most commonly used in housing paper objects. It is one of the most dimensionally stable and chemically inert plastics available.

It is important to note that objects with powdery or friable media, such as charcoal or pastel drawings, some drawings or documents in graphite pencil, or any object with cracking or peeling media, should not be exhibited or stored in plastics. The plastic's static charge can attract the loose media.

b. Supply Formats

The second basic principle is to provide housing in the enclosure format which is most appropriate for the object. A familiar generalization is that mats are the enclosure of choice for works of art on paper and folders for archival records. In fact, either of these as well as other types of enclosures may be suitable for art, archival records, and other types of paper objects.

The appropriate format of the object's enclosure is determined by its physical needs. These in turn are determined by considering the format of the object, the media and materials used to make it, and its condition. Examples of each are as follows:

<u>Format</u>:

- flat single sheet (e.g., letter, print, manuscript map)
- rolled single sheet (e.g., architectural plan, map)
- bound set of sheets (e.g., pamphlet)

<u>Media and Materials</u>:

- charcoal on rag paper (e.g., drawing)
- printers ink on groundwood paper (e.g., newspaper)
- ink, watercolor on tracing paper (e.g., architectural drawing)
- ink on bond paper (e.g., letter)
- typewriter ribbon ink on bond paper (e.g., office correspondence, report)

<u>Condition</u>:

- **GOOD**: intact and structurally sound
- **FAIR**: damaged but structurally sound (e.g., waterstained)
- **FRAGILE**: intact but structurally unsound (e.g., brittle), or damaged and structurally unsound (e.g., torn, missing parts)

- **POOR**: actively deteriorating (e.g., groundwood paper, flaking paint, mold, contact adhesive residues)

Because paper objects are very vulnerable to physical damage such as tearing, the housing must fully enclose and support the object. Store smaller paper objects in folders in boxes or drawers. Within the folders, protect fragile objects within a second enclosure (e.g., polyester folder) or by interleaving.

Store flexible oversized paper objects rolled over an acid-free tube at least 3" in diameter and inserted within a larger tube. Oversize paper objects that are rigid or brittle are very difficult to house safely and usually require special arrangements.

Store most paper objects horizontally. Small flat objects (e.g., letter size manuscript materials) in good or fair condition, may be stored vertically in <u>insulated file drawers</u> and document boxes. This method is acceptable only if the objects are fully supported by protective housing enclosures and are not permitted to sag or protrude from protective folders.

Specific Types of Enclosures for Paper Objects

Descriptions of some types of enclosures and appropriate contents are as follows. (<u>Note</u>: All dimensions are in inches.) This is only a selection of enclosures; other suitable enclosures are also available.

Hybrid enclosures may be made by combining these as appropriate for particular types of objects. For example, a very brittle drawing which is frequently requested by researchers may be housed between two pieces of rigid acid-free matboard to support it physically, with a sheet of polyester film to protect its face from abrasion without obscuring the image.

1) <u>10 point and 20 point paper folders</u>. These folders range from the weight of standard file folders (10 point thickness) to what are generally called "map folders" (in 10 point and 20 point thicknesses). The 10 point folder is most often used in letter (10"x12") and legal (10"x15") size folders, and may be used in larger size folders. 20 point stock is most often used in folders over 20"x24". Being stiffer, the 20 point folder provides more support to the object and is easier to handle. In either thickness, folders are used to physically support the weight of the objects. Since the folders are flexible, they are **appropriate only for objects that may be flexed without damage.** Brittle or rigid objects may be housed in folders with added support. (See corrugated paperboard.)

2) <u>20 lb. paper folders</u>. These lightweight paper folders are used within the heavier 10 point paper folders, to protect fragile documents stored vertically in document boxes. Paper objects stored vertically tend to slip down in an enclosure and are especially vulnerable to damage at the bottom of the folder. These enclosures protect the bottom edge of the objects, and can be used to separate objects with ragged edges and those that vary in size. In addition to providing physical protection, the folders can be used to preserve archival arrangement without attaching fasteners to the objects. Refer to NPS <u>Conserve O Gram 21/5</u>, "Attachments for Multi-Page Historic Documents." They are **appropriate for single sheets and sets of sheets in good condition.**

3) <u>20 lb. paper interleaving sheets</u>. Interleaving sheets are placed between the objects within a folder. Like the 20 lb. paper folders, interleaving sheets prevent the objects from abrading or otherwise damaging each other, and can be used to preserve archival arrangement. They are **appropriate for segregating paper objects in good condition such as separating a letter from a newspaper clipping to prevent acid migration.**

4) <u>Polyester enclosures</u>. These enclosures are available in a variety of weights and seal configurations. Thicker films (e.g., 3, 5, and 10 mil) are stiffer and more easily handled than thinner films (e.g., 1 mil), and are preferred for objects larger than 10"x15" or wherever the extra volume can be accommodated.

   The enclosures may be sealed on one or more of the four sides. Each side that is sealed increases the support and protection afforded by the enclosure.

   Polyester films build up a static charge. This charge can be an advantage: it helps hold thin paper objects together within the enclosure, and helps keep unsealed enclosures closed and the objects from slipping out.

   <u>Caution</u>: Fragile objects are vulnerable to tearing as the enclosure is opened. When the two sheets of polyester are separated, their static charges pull the object in opposite directions. If one area of the object is attracted to the top sheet and another area of the object is attracted to the bottom sheet, the object can be pulled apart, especially if it is already torn or has ragged edges.

   As mentioned above, media that are powdery (e.g., charcoal, chalks, pastels) or are flaking (e.g., dessicated paint, inks) can be pulled off the paper surface by the static charge. **Do not use polyester enclosures for objects with powdery or flaking media.**

a) <u>Polyester folders</u>. These folders are sealed on one side, usually lengthwise. Also called "processing folders", these enclosures are **appropriate as temporary housing for fragile single sheets being processed** (e.g., cataloged or treated), and to protect single sheets during handling by a researcher.

b) <u>Polyester L-seal pockets</u>. These enclosures are sealed on two adjacent sides, providing more support than the polyester folder. The object must be put into the enclosure very carefully to avoid damaging it as it is inserted into the sealed corner of the enclosure. These enclosures are **appropriate for thin pamphlets, for single sets of sheets in fragile condition, and for single sheets of groundwood paper.**

c) <u>Polyester sleeves</u>. These sleeves are sealed on two opposite sides, usually the long sides. In small sizes (e.g., 10"x15") and when used with a tight fitting rigid insert (e.g., 2- or 4-ply matboard), these enclosures are **appropriate for thin objects that cannot be flexed,** (e.g., placards and photographs).

d) <u>Polyester 3-seal pockets</u>. These enclosures are "open-short" or "open-long", depending on which one of the four sides is left unsealed. An open-short pocket provides more support than an open-long pocket and is usually preferred. These are **appropriate for thick pamphlets and bulky objects, and with rigid inserts for objects which cannot be flexed.**

e) <u>Polyester multi-pocket sheets</u>. These sheets are available in various sizes with pockets that vary in size depending on the number of pockets per sheet. They minimize the storage volume required by objects that are less than half as big as the standard size in which they are to be housed. For example, advertising cards are to be stored with related records in 10"x15" document boxes. Eight 3"x4" cards can be stored in a multi-pocket sheet, taking up a fraction of the space they would require if stored separately. These enclosures are **appropriate for single sheets and sets of sheets in fragile to good condition.**

Enclosues like these can be made by sealing two sheets of polyester together with ultrasonic vibration, with heat, or with double-sided pressure sensitive tape. The ultrasonic and heat seals are preferred. The commercially available polyester enclosures listed above are made with ultrasonic or heat seals in standard and custom sizes. Parks with large paper collections may wish to purchase ultrasonic or heat-sealing equipment to make their own enclosures.

If tape is used to seal polyester, exercise care applying the tape to ensure that the object does not come in contact with the tape's adhesive. There is only one double-sided tape that meets the standards for archival quality (established by the Library of Congress Research Office): 3-M Scotch Brand Double-coated Tape No. 415®. This tape is made up of an acrylic adhesive on a polyester film carrier. It is acceptable only for use in making enclosures. Never use tape directly on the paper object.

f) Encapsulation. Another technique that can be used to house objects in plastic is known as encapsulation. In this enclosure all four sides of the enclosure are sealed to create a capsule, with the corners left open to permit air circulation. Procedures for encapsulating documents are provided in NPS Conserve O Gram 13/3.

Encapsulation may be appropriate for extremely brittle documents, or documents already torn or crumbling, particularly those that are handled frequently for research use. Some museums also encapsulate documents sent off site on loan, specifying that the object must be maintained in the capsule until it is returned.

Ideally, acidic documents should be deacidified by a conservator before they are encapsulated long term. Research has shown that when acidic documents are encapsulated, the aging process is accelerated. The procedure may thus be undesirable unless the objects are frequently handled, or severely deteriorated.

For acidic documents or works of art done only on one side of a sheet of paper, a sheet of buffered tissue placed behind the object within the capsule appears to off set the build up of acidity.

5) **Matboard enclosures**. A variety of enclosures can be made with museum quality matboard. Instructions for mounting paper objects in standard mats are provided in NPS Conserve O Grams 13/1 and 13/7. Instructions for preparing variations on the window mat are available from the Preservation Office of the Library of Congress.

The basic window mat is made of a backboard, to which the object is attached with paper hinges or corners. The backboard is hinged with gummed cloth tape to a window mat, through whose window the object is visible to the viewer. This is **appropriate for objects being framed for exhibition.** In combination with an interleaving sheet of non-abrasive acid-free paper such as glassine, window mats are also **appropriate for storing objects with media which must not be touched** by the housing enclosure (e.g., powdery or flaking media).

Matboard is available in various thicknesses, most commonly 2-ply, 4-ply, and 8-ply. It is usually somewhat flexible. Small pieces are rigid enough to provide physical support for small brittle objects.

Matboard cut to standard sizes can be used within other enclosures to provide extra physical support. Within polyester sleeves, the matboard provides the rigidity necessary for small brittle objects. Within document boxes, matboard may be used to separate different size objects and prevent the uneven distribution of packing pressure within the box. Cut larger than the standard size, matboard is an appropriate handling support for flexible objects.

6) Corrugated paperboard. Similar in its uses to matboard, corrugated paperboard is much stronger. It can also be used to evenly distribute the weight of different size objects within boxes and as a handling support.

Single walled corrugated paperboard can be creased and folded to some extent, and used to make spacers to customize standard size boxes to fit odd-size objects, to divide map case drawers, and to make wedges to fill space within document boxes. Single walled corrugated paperboard tends to warp in large sizes. The double walled version does not warp, and is stronger than the single walled. It cannot be folded, but is useful as a rigid support for larger or heavier objects.

7) Boxes. Boxes are available in a variety of designs for vertical and horizontal storage of objects. Box descriptions can be confusing. The style names of boxes often refer to a specific use (e.g., shoe box, suit box), although the box may be appropriate for other types of objects. Different manufacturers may call the same box by different names.

Boxes are **appropriate for objects in enclosures** (e.g., mats, folders) **as well as for loose objects** (e.g., three-dimensional paper objects, collections of catalog cards, index cards). The box should not be so large that it is too heavy or unwieldy to carry easily.

Consider using a number of smaller boxes rather than one large box to house a series of objects. Smaller boxes are easier to handle. In addition, breaking the series into a number of boxes will cut down on the number of objects that must be handled to retrieve a given object from its box.

All boxes should have covers so that they can be closed. Boxes with a **drop-front** are held closed by the box lid. When the lid is removed, the front can be dropped so that objects can be slid out rather than lifted out of the box. The

enclosures can fit very snugly, since room to reach into a drop-front box is not necessary.

a) <u>Document boxes</u> are either used for vertical or horizontal storage of paper objects, again, ensuring that all papers are fully supported. Sizes vary, the most common ranging from 3"x5" up to legal size (10"x15"). The box has a hinged lid that swings up and behind the box. Objects are removed by lifting the enclosure up and out. The box may have a handle to facilitate pulling it off the shelf. String handles are acceptable if the ends are glued between the layers of the paperboard of which the box is made. Do not use handles that protrude into the interior space of the box (e.g., polyethylene straps hooked into holes in the box). These handles can catch on the enclosures and objects inside the box and can cause severe damage.

b) <u>Shoe boxes</u> are also used for vertical storage of paper objects, such as index cards, bumper stickers and decals. These boxes have lids that fit over the top and extend down the sides of the box. "Telescoping" lids extend all the way to the bottom of the box and add to the strength of the box. Telescoping lids can be difficult to remove, especially from a deep box. "Short" lids are the alternative to telescoping lids, and are usually about 1-1/2" deep.

c) <u>Solander</u> or <u>clamshell boxes</u> are used for horizontal storage of paper objects, usually in mats or folders. To store objects of varied sizes, the objects can all be housed in folders or mats with exterior dimensions cut to fit the interior of the box. The objects then are stored uniformly, and will not shift or slide in the box. These boxes are hinged so that the top of the box swings over to provide a continuous surface for handling objects. They are appropriate for the storage of works of art on paper.

d) <u>Shirt boxes</u> and <u>suit boxes</u> are similar in style to shoe boxes, but are sized in different proportions, for horizontal storage of paper objects.

e) <u>Archival Records Storage Boxes</u> are 10" x 12" x 15" boxes made of acid-free and buffered corrugated fiberboard or polyethylene. Hand holes are cut into either end of the box for carrying, and the short lid lifts off. These boxes are generally used for the vertical storage of papers housed in folders, and in good to fair condition. For this reason, they should not be used to hold fragile archival materials or those of high intrinsic value.

8) **Map Drawers**. Like boxes, map drawers are appropriate for objects in enclosures (e.g., mats, folders), as well as for objects that are not feasibly enclosed within the drawer (e.g., three-dimensional objects). Shallow drawers are preferred over deep drawers for storing objects in folders and mats. Shallow drawers provide the most efficient use of space, since stacks are usually limited to one inch in height. Refer to section on storage equipment for guidance. To provide a snug fit for a variety of standard sizes, fill in extra space in the drawer with spacers made of folded acid-free material such as folder stock, matboard or corrugated paperboard.

c. Standard Supply Sizes

One of the most important principles is to have a modular system of standard sizes. Standard size enclosures can be ordered in bulk, stored more efficiently and used more quickly than enclosures that are custom-sized to each object.

Whenever dimensions are given in supply catalogs, determine whether they are "inside dimensions" (I.D.) or "outside dimensions" (O.D.). The way the enclosure is measured becomes critical when combining enclosures made by different manufactuers. For example, 10"x15" folders should fit into a 10-1/4" x 15-1/4" box, but they may not unless the box was measured on the inside.

Paper is specified by <u>weight</u>: 20 lb. paper is similar to bond paper.

The thickness of heavier weight paper and cardboard is specified by <u>point</u>: 10 point paper is similar in thickness to an index card.

The thickness of polyester film is specified by <u>mil</u>: 1 mil polyester film feels similar in thickness to kitchen-grade plastic wrap.

In evaluating the specifications for a particular enclosure it is useful to have a collection of labelled samples of housing materials and enclosures. Most suppliers will send a sample of a particular product upon request. Selected supplies are available from the Curatorial Services Division, Harpers Ferry Office.

It is critical that the enclosures within each standard size fit snugly together. If the enclosures do not fit snugly, then the enclosed objects may not be fully protected. For example, if the folders within a drawer can slide around as the drawer is opened and closed, then there is room for the objects to slip out of their enclosures and become torn, crushed, and otherwise damaged.

When storing paper objects together in drawers or boxes, always house them in the same size enclosures. When different size enclosures are interfiled, the smaller enclosures cannot fully

support the larger ones, allowing the larger objects to sag and become distorted. Paper objects in the smaller enclosures may be overlooked or misplaced, or may slip out of their enclosures and become damaged.

Sometimes objects that vary in size must be interfiled for archival reasons. In such cases, **the appropriate standard size is determined by the largest object,** and all of the objects are housed in enclosures of that size. Always ensure that an enclosure is larger than the objects it contains.

5. <u>Museum Collections Storage Equipment</u>

Storage furniture is required to physically support paper objects within their housing enclosures. Ideally, the furniture will also afford protection from abrupt changes in the environment and pest infestations, and will maximize the available storage space. Refer to Chapter 7 for guidance on museum collections storage.

Unless documents are in very good condition, and are very well supported by their enclosures, they should not be stored vertically in file cabinets. Most paper objects can be accommodated with two basic kinds of equipment: shelves and map cases. Shelves are appropriate for storing objects in closed housings such as acid-free boxes and tubes. Tubes (with objects inside, not rolled around the outside) can be stacked in a honeycomb pattern to allow efficient arrangement of rolled items in storage. Modular storage units afford the most efficient use of space and the most efficient retrieval of objects.

Some boxes will tolerate being stacked, but most will gradually compress under the weight of the object above. Depending on the shape of the box and the weight placed on it, some boxes cannot be stacked at all, even temporarily, without damaging the objects inside. Even if the box is strong and designed to be stacked, if it becomes squashed, dented or otherwise damaged, it will not provide adequate physical protection for the objects inside.

<u>Avoid stacking boxes whenever possible</u>. If equipment shelves are adjustable, space them closely enough to allow each box to be placed directly on a shelf. If it is necessary to stack boxes, ensure that 1) the sides and top of each box are not creased or caved in, and that 2) each box is fully supporting the weight above it rather than allowing weight to rest on the objects inside.

Objects too large for boxes are appropriately stored within folders in map cases. Folders are usually stacked within each drawer. The weight on the bottom objects increases as more objects are stacked on top. Objects under heavy weight can be creased and compressed, and are vulnerable to damage during retrieval. Avoid stacking folders more than one inch deep. Less space is wasted if the drawers are shallow, e.g., 1-1/2" deep. Even if the drawers are several inches deep, the stacks of folders within them should not exceed one inch.

Store objects of varying sizes in uniform folders that conform to the size of the drawer. Drawers can be subdivided with acid-free paperboard to safely hold two or more stacks of folders or rows of rolled objects.

Like all materials used near paper objects, the storage equipment must be as chemically inert as possible. Objects stored in enclosed spaces such as storage cabinets and exhibit cases are especially vulnerable to damage from fumes given off by materials used to make the furniture such as wood, adhesives, gaskets, and paint. Acceptable materials include galvanized steel, steel with a baked enamel finish, chrome finish, stainless steel, or anodized aluminum. In some instances with baked enamel finishes, components of the finish may not have been adequately cured in the manufacturing process. If an odor is noted in new closed cabinetry, allow the unit to air before use.

6. Handling

Historic objects are often in fragile condition, requiring more than ordinary care to handle them safely. At the same time, some people who use paper collections are concentrating on their particular project (e.g., research or finding an object suitable to exhibit) rather than careful handling. Others may simply be unaware of the damage that results from careless handling. It is imperative that each person who handles objects be trained, and take the time necessary to do it safely. **Note: Damage from mishandling is preventable.**

As stated in Chapter 6, a set of rules for handling objects is essential. Prepare a written set of procedures for handling objects, including paper objects; distribute them to appropriate park staff, and post them in a location that will serve as a reminder. Enforcing the policy may not seem easy, depending on the interpersonal skills of the curator and the person requesting an exception, especially when the procedures are new. Keep in mind that handling procedures are necessary to preserve the collections, and they only work if they are consistently enforced.

Chapter 6 outlines the general guidelines for ensuring object safety during handling and moving. One general rule needs to be emphasized when working with paper objects: **Never rush when handling objects.** The basic principles of safe handling are as follows: limit handling, provide a clean and uncluttered workspace, and provide each object with appropriate support.

a. Limit Handling. One way to limit handling of objects in storage is to create inventories, container lists, finding aids and box and folder labels that eliminate the need to physically search through the housing enclosures. The number of people who handle an object should be limited as well. Handling of paper objects by researchers and park staff should always be overseen by a staff

person with collections responsibilities. Ideally, only trained staff should handle oversized papers such as maps or architectural plans.

If a limited number of paper objects is to be used by a researcher, they should be placed inside a rigid sealed enclosure or plastic sleeve to protect them from handling. Whenever use is frequent, facsimiles or duplicates should be used by researchers instead of original paper objects. Refer to NPS Conserve O Gram 21/3, "Archives: Preservation Through Photocopying" for guidelines on producing copies of original paper documents. This Conserve O Gram describes the kinds of documents that should be photocopied to preserve their informational content (e.g., Mimeograph or Thermofax copies that are deteriorating, brittle and deteriorating highly acidic papers, newspaper clippings) or that should be copied in order to preserve them from repeated handling by researchers or deterioration through exhibition. The Conserve O Gram also discusses the kinds of copiers, toners, and papers that should be used to produce stable copies.

b. Clean and Uncluttered Workspace. Transport paper objects only within their protective housing enclosures (e.g., folders). If the object is to be removed from its enclosure (e.g., for examination by a researcher), provide a workspace that has a clean, flat and uncluttered surface. The general rule is to provide plenty of room to open the enclosure and remove the object.

c. Appropriate Support. Paper objects require support of various types, depending on their format and condition. The purpose of supporting the object during handling is to relieve the object of the strain of its own weight. The support may be long-term, as provided by the object's housing enclosure, or may be temporary, as provided by a rigid paperboard on which an object is carried to the user.

Since the risk of damage is much greater when the object is being handled than when it lies undisturbed in storage, objects often require support during handling in addition to that provided by their housing enclosures. This principle is elaborated in the following section.

d. Specific Handling Techniques for Paper Objects.

Small paper objects that are sound structurally, intact and lightweight usually do not require additional support for limited handling. A manuscript letter on rag paper in good condition requires no more support for handling than its acid-free folder.

A fragile architectural plan on tracing paper is appropriately housed in a polyester encapsulation. It may be safely handled within the encapsulation.

Sometimes there is a need to handle paper objects directly (e.g., preparatory to properly housing them). Whenever objects are handled directly, they are particularly vulnerable to damage.

Always use both hands. Never hold an object by one corner; the strain on the object can cause structural damage. Instead, if it is a small object, allow the weight of the object to rest on your hands. Hold rolled objects similarly, with the weight of the roll resting on your hands. **Never grasp a rolled object:** it can easily be crushed.

When placing a brittle object on its support, it is usually safest, rather than lifting the object, to place the support on the same level as the object and gently slide the object onto it.

For rigid supports, lightweight materials such as corrugated paperboard are easiest to handle. These provide adequate protection for carrying objects by hand.

A closed support such as a portfolio (e.g., a rigid folder-style enclosure) provides more protection than an open support such as a tray or a piece of rigid paperboard. Make an acid- free portfolio from two sheets of archival corrugated paperboard, taped along one long side with water-activated linen tape. Any object carried in the portfolio should be in another enclosure (e.g., an acid-free folder or a polyester folder) for further protection.

Use a closed support when carrying the object outside of the building or through a route with tripping hazards or tight fits. An open support is usually adequate for limited handling such as moving an object from one table to another. **Handle the object by its support.**

Large rolled objects can be problematic to handle safely. In the best cases, the object can be unrolled without stress. More often, the object tends to curl up as it is unrolled.

If the object is brittle or dessicated, do not attempt to unroll it. These objects require treatment by a conservator before they can be viewed.

If the object is flexible, it often can be unrolled even if it tends to curl. Small weights such as 35mm film canisters filled with lead shot can be used to hold down the object's edges. The weights must be smooth and clean to prevent damaging the object.

If the object is too long for the available table space, it can be "scrolled". To scroll through a rolled object, unroll only as much as can be supported by the examination surface. After examining the exposed part of the object, re-roll the object from its free end. This gives you two rolls. Carefully shift the position of the object so that more of it can be unrolled. Unroll the next part of the object and proceed until all of it has been

examined. Be very cautious when unrolling objects: the edges of tears tend to spring apart and can cause the object to be torn further.

Objects being inserted into or removed from polyester enclosures are extremely vulnerable to tearing because of the static charge on the polyester film. To insert a limp or very lightweight object into a polyester enclosure, it is sometimes useful to use a sheet of 20 lb. acid-free paper as a temporary support. As you hold the enclosure open, insert the object on its support. Allow the enclosure to close, and very lightly rub the polyester film with a lint-free cloth (e.g., cheesecloth) to build up a charge directly over the object. Carefully slip the support paper out of the enclosure. The static charge should help to keep the object in place.

Watch very carefully and go slowly when removing an object from a polyester enclosure. If the enclosure is to be removed, cut through the polyester, carefully avoiding the object. The least strain is placed on the object if the seals are cut. Be extremely careful not to damage the object. If the object is being damaged, do not persist in removing it. It is better to sacrifice the enclosure, than to damage the object.

If the enclosure is open on at least three sides, remove the top sheet of polyester film by rolling it up. If the object is torn and the edges of a tear are not adhering to the same piece of polyester film, gently separate the errant edge from the film with a microspatula and hold it down to the appropriate piece of polyester while you lift the other sheet away.

If the enclosure is sealed with an L-seal, separate the top sheet by lifting its free corner before removing the object. If the enclosure is open on only one side, separate the pieces of polyester film at the edge of the opening by inserting a microspatula or other flat tool. If possible, insert a piece of acid-free paper to support the object as you remove it.

7. <u>Exhibition</u>

One of the greatest challenges is to find an acceptable balance between the benefits of exhibiting original paper objects and the resulting damage. For objects with high intrinsic value, there is no level of loss which is acceptable. For other objects (e.g., those with no intrinsic value that are duplicated in the collection), there may be a level of loss which is acceptable (e.g., fading of color which is imperceptible to the human eye).

Because of the risk to the object, six months is usually considered the maximum time for original paper objects to be placed on exhibit. **For a permanent exhibit, <u>only facsimiles are appropriate</u>.** It is important to distinguish <u>facsimiles</u>, which are new copies of the

original object, from original objects that exist in historical duplicates (e.g., lithographs, blueprints).

There may be some objects such as lithograph maps that exist in the collection in several identical copies. In some cases, it may be appropriate to treat one of these copies as a facsimile for exhibition purposes. Note: It is not appropriate to treat all historical duplicates as facsimiles.

Some paper objects that were created as duplicates may now be more appropriately considered unique objects. For example, there are working drawings (e.g., blueprints that were originally printed in multiple copies), that have annotations documenting plan changes made during the construction. Such working drawings are unique objects by virtue of the unique annotations. Other objects that may have once existed in multiple copies may now be considered unique by virtue of being the only extant copy.

There are measures that can be taken to limit the risk of exhibiting paper objects. The principles behind these measures are as follows: house the object with appropriate materials in the format that will best support the object and limit the object's exposure to harmful environmental conditions (e.g., temperature, relative humidity, light, air pollution) and to pests.

a. Exhibition Housing Enclosures

Paper objects on exhibition require special protection. Their housing enclosures must physically support them so that the display itself does not cause mechanical damage, and must protect them from direct handling and vandalism.

Exhibitions are sometimes designed to produce a visual effect (e.g., all objects are enclosed in identical mats and frames without considering the preservation of the individual objects). For the safety of the objects, design exhibition housings to satisfy the physical need of each object.

Most paper objects are exhibited in frames and/or in exhibit cases. Frames are most appropriate for single sheet objects (e.g., prints, drawings, manuscript materials) that are strong enough to be displayed upright. Cases are required for objects that cannot be safely housed in a mat (e.g., multi-sheet, large, thick or heavy objects).

As for all housing enclosures, the exhibition mats and mounts must be larger than the object to fully protect the object's edges. **Never fold or trim an object to fit into a housing enclosure.**

Refer to NPS Conserve O Gram 13/7, "Exhibit Mounting Variations for Objects on Paper" and NPS Conserve O Gram 13/1, "Conservation Framing" for technical guidance on mounts and frames.

1) Matting and framing

Ideally, overmat all paper objects that are framed. In an overmat, the window is smaller than the object so the mat covers the object's edge by at least 1/4" on small objects and proportionally more on larger objects. This technique prevents the object from popping through the window mat.

If is not possible to cover the edges of the object (e.g., the image goes to the edge of the paper), "float" the object within its window mat, by centering it inside a window that is larger than the object and attaching with hinges.

Many objects, (e.g., broadsides, posters), that are desirable to float are not structurally sound enough to be hung within the mat by hinges. These objects may only be displayed in mats if they are first encapsulated, and the encapsulation, rather than the object itself, attached to the mat. Seal the polyester film within 1/8" of the edges of the object as usual, but leave large margins outside the seal. Cut the window of the mat to barely cover the seal. If the encapsulation is the same size as the mat, taping it to the mat to keep it in position may not be necessary.

If the encapsulation is smaller than the mat, use double-sided tape to hold the polyester film margins to the matboard. To remove the encapsulated object from the mat, simply trim the margins. If the object is to remain in the encapsulation for storage, the encapsulation should fit one of the standard sizes after trimming.

If the object is strong enough to be floated without being encapsulated, hinge it intermittently along all edges to prevent the paper from being attracted to the glazing. If the object is not strong enough to be hinged, and it cannot be encapsulated (e.g., a pastel drawing on brittle newsprint), **do not display it upright.**

In some cases (e.g., with some modern works of art on paper) a mat is not appropriate aesthetically. If a framed paper object is not matted, its mount must be rigid so that it will not bow in the frame, and the mount must be separated from the glazing with spacers. Encapsulation is usually not acceptable visually for framed objects without mats. In this case, hinge the object to the mount. As with objects floated in mats, hinge the object along all sides.

For an object housed in an historic mat and frame that must be retained (e.g., a decorative object in a historic room or house), substitute acid-free for acidic materials as much as is possible and appropriate for the particular object. In some cases, the design of a historic mat can be recreated (e.g., an acidic French mat, with modern acid-free

materials). An historic frame's wooden backing can be replaced with museum quality matboard or corrugated paperboard. Where historic parts cannot or should not be replaced, line them with acid-free materials (e.g., by placing a two-ply acid-free mat between the object and its acidic historic mat).

2) Exhibit Cases

Paper objects are sometimes displayed horizontally in exhibition cases, usually on unobtrusive exhibition mounts. The mounts may be made of any material that is appropriate for housing paper objects and strong enough to fully support the object (e.g., acid-free matboard and acid-free corrugated paperboard).

Unless the relative humidity within the case is rigidly controlled, paper objects will expand and contract continuously as changes in temperature cause the RH within the closed case to fluctuate. For this reason, unless the object is in a sealed enclosure, **the mount must be larger than and must not constrain the object.** Mounts that are the same size or smaller than the object and constrain it will damage the object as it expands.

If the object is displayed horizontally, it must be attached to its mount. If it is displayed at an angle, it also must be attached to its mount to keep it from slipping down gradually.

Hinge an object to its mount with the technique used to hinge an object to a mat. If hinging is not appropriate, hold the object to its mount with a sheet of polyester film wrapped around to the back of the mount. This is a sealed enclosure, appropriate only for objects that may be safely encapsulated.

Never hold the object with fishing line or with straps of polyester film. Both of these materials are unresponsive to changes in relative humidity, and can cut the paper if they expand. Although it appears to be transparent, polyester film blocks out some of the light falling on the object, causing differential fading under the straps if they cross the image area.

A rolled object may be partially unrolled for an exhibit within a closed case, and weighted to prevent it from curling up. Transparent weights such as pieces of acrylic sheeting or glass with rounded edges and corners are usually the least obtrusive. Like polyester film, these materials can cause differential fading and <u>should not</u> be placed over the image.

b. Environment

1) Temperature and relative humidity

Paper objects on exhibition are responsive to changes in temperature and relative humidity. These agents are usually more difficult to control in exhibit spaces than in storage. Opening and closing doors circulate unconditioned air into the space. People add to the temperature with body heat and to the RH with perspiration and respiration. This effect can be very pronounced in the immediate area of an object which exhibition visitors study closely (e.g., an autograph). To protect the objects from abrupt changes in their environment, seal cases and frames as effectively as possible.

A sealed frame provides the enclosed object with some protection. If the glazing cannot be removed from the frame, both the glazing and the backboard should be sealed to the frame with plastic tape. If the glazing is not attached to the frame, make a sandwich with the matted object between the glazing and the frame backboard, sealed along all four edges with a plastic tape such as 3M's Magic Mend 810 (<u>not</u> for use in contact with paper objects) available through GSA. The sandwich is placed between the glazing and backboard and lowered into the frame in its entirety. Unframed objects may be sealed within a similar sandwich, in an encapsulation or in a hybrid enclosure, (e.g., between polyester film and 4-ply acid-free matboard).

It is possible to better control the relative humidity within a sealed exhibit case (e.g., with silica gel), if the outside environment is fairly stable. Refer to Appendix I, "Care of Archeological Objects," Section E for guidance on the use of silica gel. Historic exhibit cases can usually be repaired and sealed with caulking. Remember to remove the objects from the cases before starting any repair work. Most modern cases are designed with gasketing for a tight seal. Make sure the sealants, (e.g., caulking, gaskets), do not give off harmful vapors.

2) Light

Because the effect of light on paper objects is cumulative, the levels of light must be strictly controlled to acceptable levels and the length of time that the object is on exhibit must be limited.

50 lux (5 footcandles) is the maximum acceptable visible light level standard for exhibition of paper objects. While all paper objects are sensitive to light, they range from less sensitive objects (e.g., a print in black ink on white rag paper) to objects with colored paper or media such as

blueprints and watercolors. Exhibit paper objects at no more than 50 lux for no longer than six months.

Never expose objects to direct sunlight. Where sunlight is required (e.g., to recreate a historic interior, replace original paper objects with facsimiles). Even where it is possible to reduce visible light levels to acceptable levels, protect the objects from ultraviolet radiation by placing UV filtering material between the object and the light source.

Cover fluorescent bulbs with UV-filtering plastic tubes. Coat glass with UV-filtering film. Where acrylic sheeting can be used instead of glass (again, not recommended with friable media), in frames and in cases, ensure that it is the UV-filtering type. Refer to the NPS Tools of the Trade for sources of light controlling materials.

8. Monitoring and Reporting Condition of Paper Objects

Any time a paper object is viewed or handled provides an excellent opportunity to monitor and report on its condition. Handling objects for accessioning and cataloging, in preparation for research use, before and after an exhibition, and at any other time allows the curatorial staff to examine each object and assess its condition. Depending on the object's condition, the use for which it is being prepared may or may not be appropriate.

Viewing objects (e.g., on exhibit), usually provides less information than can be gained by actually handling an object, but a strictly visual inspection can be done relatively quickly and often combined with other tasks (e.g., monitoring the amount of light falling on each object in the exhibition).

There is a difference between a **technical examination** by which a conservator determines the materials, media, and methods of fabrication of an object, and the **condition report** that curatorial staff can use to document the condition of objects in the museum collection. In the Service, the Conservation Survey prepared by a conservator, is called a Collection Condition Survey. Refer to Chapter 3 for guidance on this survey.

The curatorial condition report, typically much briefer than a Collection Condition Survey, focuses on the overall physical condition of the object. The emphasis should be on recording any visible deterioration/damage at the time of inspection. Objects are inspected item-by-item, and the results are reported on the individual or group level. The group may be as small as two objects or as large as a series or the entire collection. The results reported on the individual or small group level may be summarized to provide information on larger groups or on the collection as a whole.

Monitoring and recording the condition of each object is considered **surveying at the item level.** This kind of report is especially appropriate for comparing the condition of the object before and after a given event (e.g., loan for a traveling exhibition). Figure J.2 provides a checklist that trained curatorial staff can use to document the condition of the object and its housing. Refer to Section G of this appendix for a glossary of terms used to describe the condition of paper objects.

Information on the collection's condition can also be gathered during projects that require handling, such as the rehousing of a group of objects. An example of a condition report for a group of rehoused records is given in Figure J.3 a-b. For this report, the objects are **inspected at the item level and reported at the group level.** The group is one document box of paper objects thematically described by the curator. The report records the total number of objects at the top left. This total is broken down along the left vertical column by type of object, and across the other columns by condition. The numbers are totalled by column and converted to percentages at the top to give information at the group level (e.g., how many items in the folder are torn).

As each document box of objects is rehoused, a report on the condition of the collection is generated. The report, which can be summarized to give information about the collection, gives information about the objects within each box. Information reported at this level is very useful in planning conservation projects ranging in scope from the smallest group of objects to the entire collection.

For large collections the condition of the collection may be estimated based on the inspection of a small number of objects in a **random sample survey.** The objects are usually selected by storage location using a number code for each location and a list of random numbers generated by a computer. This type of survey is the most efficient way to gather information on the condition of a very large collection.

Regardless of the number of objects inspected and the level of reporting, **the condition must be consistently described according to precise definitions.** Otherwise the information gathered and recorded will be very limited in its usefulness. It is critical that anyone who monitors the condition of paper objects be trained to recognize the different states of condition, and that the criteria for each category of condition be recorded. This approach ensures that:

- The results are reproducible (e.g., different people surveying the same objects will report the same information).

- The results are intelligible (e.g., anyone who evaluates the results will know what is meant by the descriptive terms used to record the condition of the paper object[s]).

PAPER OBJECT CONDITION REPORT

Object:____________________ Accession No.________ Catalog No.___________

Examined by: ____________________________ Date:____________

Type of Object (e.g., booklet, broadside, letter, map, print):

Type of Mounting (e.g., encapsulation, matted):

Reason for Examination: __New Accession __Outgoing Loan/Transfer
__Pre-Treatment __Returned Loan/Transfer
__Accidental Damage/Disaster

Signs of Deterioration Noted: __Yes __No (If yes, describe below)
Active Deterioration Noted: __Yes __No (If yes, describe below)
Object Needs to be Examined by a Conservator: __Yes __No
Object's Condition Photographed: __Yes __No

Signs of Deterioration Noted (Check Appropriate Conditions)

__Accretions	__ Discolored/Faded	__ Hole	__ Surface Dirt
__Abraded	__ Discolored/Stained	__ Loss	__ Unraveling
__Burned	__ Dessicated	__ Tear	__ Worn
__Break	__ Fasteners	__ Soiled	__ Scratches
__Brittle	__ Flaking	__ Adhesive	__ Plastic/Paper Tape
__Creased	__ Insect Damage	Residues	__ Wrinkles/Draws
__Cockling	__ Mold Damage		__ Loose Parts
			__ Other:______________

Comments (if appropriate, include additional description of condition)

Figure J.2. Curatorial Condition Report for Paper Objects

CONDITION OF PAPER COLLECTIONS: GROUP SURVEY REPORT

Material Surveyed: ______________________________ Accession No. ________
Total Objects Surveyed: _______
Examined by: ______________________________ Date: ________________

Frequency		Faded	Discolored	Brittle	Soil	Stains	Adhesive, Residues, Tapes	Creases	Tears	Losses/Holes	Original Fasteners	Added Fasteners	Other:
	Advertising Card												
	Album/Scrapbook Page												
	Announcement												
	Ballot												
	Book												
	Booklet												
	Broadside												
	Bumper Sticker												
	Calling Card												
	Cartoon												
	Certificate												
	Circular												
	Clipping												
	Decal												
	Drawing												
	Elector Ticket												
	Illustration												
	Invitation												
	Leaflet												
	Manuscript/Typescript												
	Map												
	Newspaper												
	Notebook												
	Painting												
	Pamphlet												
	Periodical												
	Photograph												
	Placard												
	Popcorn Box (Flat)												
	Portrait												
	Postcard												
	Poster												
	Press Release												
	Print												
	Receipt												
	Sheet Music												
	Stamp												
	Stereophotograph												
	Ticket												
	Other:												

Figure J.3a. Condition of Paper Collections: Group Survey Report

CONDITION OF PAPER COLLECTIONS: GROUP SURVEY REPORT

Material Surveyed: Smith and Co. Records Accession No. OZLO-4
Total Objects Surveyed: 129
Examined by: A. Jones Date: 5/7/88

Frequency		Faded	Discolored	Brittle	Soil	Stains	Adhesive, Residues, Tapes	Creases	Tears	Losses/Holes	Original Fasteners	Added Fasteners	Other:
		2 2%	84 65%	10 8%	95 74%	69 53%	61 47%	10 8%	13 10%	11 9%	9 7%		4 3%
	Advertising Card												
	Album/Scrapbook Page												
	Announcement												
	Ballot												
	Book												
	Booklet												
1	Broadside		1				1						
	Bumper Sticker												
	Calling Card				1		2						
2	Cartoon		1										
1	Certificate		1	1	1	1				1			
	Circular												
7	Clipping		1	3	1		3		1		1		2-mounted
	Decal												
	Drawing												
	Elector Ticket												
2	Illustration		2		1		1						
1	Invitation		1		1								
3	Leaflet		2						1				
	Manuscript/Typescript												
	Map												
	Newspaper												
	Notebook												
	Painting												
8	Pamphlet	1	3	2	3	1		2	3	2	8		
	Periodical												
2	Photograph						1	1					
	Placard												
	Popcorn Box (Flat)												
94	Portrait		68	3	83	65	49	7	8	8			2-scratch
1	Postcard		1		1		1						
	Poster												
	Press Release												
3	Print		3		3	2	3						
	Receipt												
	Sheet Music												
	Stamp												
	Stereophotograph												
	Ticket												
	Other:												
2	Calendar	1											
1	Program			1									
1	Photocopy of Ms.												
129		2	84	10	95	69	61	10	13	11	9		4

Figure J.3b. Condition of Paper Collections: Group Survey Report (Example)

E. CONSERVATION TREATMENT ISSUES

As stated in Chapter 8, conservation treatments are carried out by a professional conservator. They include interventive techniques to stabilize deteriorating fabric of an object, and restoration. Stabilizing treatment of an object may be undertaken to remove foreign materials, to reverse inexpert or inappropriate repairs, to halt active deterioration, and to make the object chemically and structurally sound. The goal of conservation treatment is to preserve the historic integrity (e.g., construction and materials) of the paper object. The curator works with the conservator to identify a desirable degree of treatment.

Have a Collection Condition Survey for paper objects in the collection completed by a paper conservator to establish priorities for treatment. Refer to Chapter 3 for guidance on Collection Condition Surveys.

1. Stabilization Treatment

Before beginning any treatment, the conservator thoroughly examines the object to determine its condition and its material components. If treatment with water or other solvents is needed, the conservator tests the solubility of all applied media such as inks, paints, and adhesives. Based on all of this information, the conservator prepares a written treatment proposal for curatorial staff to review and approve. Often, a number of treatment options are equally appropriate. The curatorial staff's choice of treatment will depend on a number of factors, such as how much and what kind of use is expected for the object, the size of the budget, and the number of objects requiring treatment. An example of this level of conservation treatment is as follows:

Paper records that had been water-damaged in a flood and subsequently freeze-dried were stuck together. The conservator examined them and found that the pages were made of rag paper, and were adhered to each other at "tidelines" with a watersoluble adhesive. Tidelines are formed at the edges of a waterstain where the staining and any dissolved material are concentrated as the water dries. This phenomenon is similar to the deposition of debris on the beach at the high water mark. The adhesive, originally used in the cloth and paper report binders which housed the records, had been dissolved by the floodwater and then redeposited in the paper objects as the water dried.

The proposed treatment stated that there was a risk: <u>removing the adhesive would probably remove at least some of the pencil directly under it</u>. However, the proposed treatment was approved. The curator advised the conservator that the records were part of a collection in which the historic sequence of the sheets and documents is critical to their archival value and usefulness. To preserve the sequence as found, the conservator kept each document segregated, and paginated the sheets if their order was not obvious from the content or if the historic sequence was out-of-order.

The conservator used steam to reverse the adhesion of the pages, and removed the residual adhesive with cotton swabs and moisture. The pencil was less dark in the areas which had been water-damaged than in the undamaged portion of each sheet, but was still legible. After separating the pages, the conservator humidified them to relax the distortions caused by the water damage and the steaming procedure. The pages were interleaved with a nonwoven polyester web to prevent them from sticking together and dried under weight between blotters to remove excess moisture and leave them flat enough for refoldering. The records were refoldered in acid-free folders. The unlabelled cloth and paper report binders were badly distorted, and according to the curator did not warrant conservation. These were stabilized by rehousing in an acid-free box.

2. Restoration Treatment

As stated in Chapter 8, the intention of restoration is to return an object to its original appearance. To be acceptable from a conservation point of view, restoration must not compromise the historic integrity of the object. An example of restoration treatment is as follows:

Through its long history, an architectural drawing had become soiled and torn. Conservation treatment procedures were used to reduce the dirt and staining, to flatten the paper, and to mend the tears. At this point, the original materials have been stabilized. However, the drawing is not safe to handle because it is not structurally sound. The lost areas of paper along the drawing's edges make it very vulnerable to tearing. These losses needed to be filled. To complete the treatment, the fills needed only to be compatible chemically and structurally with the original paper. Restoration of the drawing was performed to prepare it for an exhibit. The restoration treatment required filling the losses with paper similar to the original paper in color and texture and recreating the lost design areas.

The conservation treatment of a paper object may be complicated by the object's history of restoration treatment. Often, materials used in earlier treatments cannot be reversed without damaging the original materials. In these cases, the conservator is limited to stabilizing the object. Sometimes previous repairs can be removed, and should be removed either because they are causing damage or because they prevent the object from being used for research or exhibition. And in some cases, objects have been repaired by masterful restorers. In such cases, the restoration may itself have artifactual value as an example of historic repair techniques, and as evidence of the history of the object. When the repair materials are of archival quality and are not causing ongoing damage to the object, they need not be removed.

3. <u>Cleaning Paper Objects</u>

Preventing dust from accumulating is much safer for the object than removing dust once it has settled. The surface of some objects cannot be thoroughly cleaned. For example, the powdery media of charcoal drawings is easily removed along with the dust. Brittle paper objects and those with ragged edges are very difficult to clean without further damaging them.

To safely clean the surface of a paper object requires unwavering concentration, and above all, training in identifying the types of objects that can be cleaned and the methods appropriate to each. Well-meaning but untrained staff can cause extensive and irreversible damage to paper objects, even with only the most preliminary attempts to clean the objects.

Objects that have accumulated surface dirt and dust will often be grimy or otherwise damaged. Only a paper conservator should attempt to do more than remove the superficial, loosely attached surface dirt from objects in otherwise good condition.

Other conditions that require objects to be referred to a conservator for cleaning include:

- Powdery media, such as chalk, charcoal, or pastel
- Flaking media, such as varnish or tempera paint
- Extensive tears or loose parts
- Extreme brittleness or other structural fragility

If the object has no such sensitive media, is intact, and structurally sound, it may be dusted with a dry, soft brush. Instruction by trained conservation staff is advisable for this basic procedure, because paper objects are so vulnerable to mechanical damage (e.g., tearing and abrasion).

4. <u>Alkalization Treatment</u>

Paper objects determined to be in an acidic condition can be neutralized or alkaline buffered to extend their life expectancy. "Deacidification" is a general term that has for some time been applied to such treatments. However, to be more precise, one or more of several treatment options can be selected by a conservator, depending upon the nature of the paper object and the desired result:

<u>Washing</u> - an aqueous treatment performed to remove acidic elements in the paper;

<u>Neutralization</u> - a treatment performed to bring the pH of the paper into the neutral range.

<u>Buffering or Alkalization</u> - an aqueous or non-aqueous procedure by which sufficient alkaline salts are deposited in the paper to protect against the build up of acidity.

Certain pigments, dyes, and inks may fade or change in color when an alkaline treatment is applied. Some types of paper also may darken. An alkalization treatment must only be performed by a paper conservator or a person who has been specifically trained in this treatment process and works under the supervision of a paper conservator.

F. EMERGENCY PROCEDURES FOR PAPER OBJECTS

A major threat to paper collections in most emergencies is water (e.g., storm, flood, pipe leak). The steps outlined below are those to be taken by site personnel immediately after the emergency. Refer to Chapter 10 for guidance on emergency planning and to Chapter 8 for general guidance on appropriate response to emergency situations involving museum objects and for the reduction or prevention of water damage.

If only a few objects are affected and the services of a conservator can be obtained within 24 hours, keep these damp objects in a cool and secure environment. If large numbers of objects are involved and the assistance of a conservator will be delayed, arrange to have water-damaged materials <u>blast frozen</u> to -28.9°C (-20°F). This service can be sought from a cold storage plant, food locker, or local supermarket; (supermarkets may not have such a low temperature). It is essential that parks with large paper collections incorporate detailed arrangements for this contingency in their Emergency Operation Plans (e.g., including phone numbers of all concerned parties, approved agreement with a company to perform this service that can be activated by a phone call, arrangements for transportation of the collection to the facility, and a ready source for materials needed to prepare the collection for freezing).

<u>Preparation of Objects for Blast Freezing</u>

1. Wrap papers (e.g., files, flat documents) in wax paper in <u>small</u> bundles no more than 12" to 15" thick. At a later time, this technique will expedite the drying process.

2. Separate the bundles of flat documents or books with wax paper to keep them from sticking together.

3. Arrange paper objects in plastic milk crates.

4. Keep books with spines in a vertical position.

5. <u>Do not unframe</u> prints or documents, except on the specific instructions of a conservator. A print or document may be frozen in its frame. Interleave each frame in a bundle with wax paper.

It is essential that all staff designated to be involved in this process receive hands-on training/experience with this process.

Once the damaged material is frozen, there is time to decide, in cooperation with a conservator, on a suitable method for drying. Arrangements can be made for valuable materials to be vacuum freeze dried. In this process, the moisture goes from a solid to a vapor state without passing through the liquid state, eliminating further water damage.

In the less expensive vacuum drying process, much of the water does return to a liquid state before drying.

G. GLOSSARY OF TERMS USED TO DESCRIBE CONDITION

Abrasion: surface loss caused by friction

Accretion: deposit of extraneous material on the surface of the object

Bloom: superficial surface cloudiness, white or blue-white, caused by moisture penetrating a surface coating, such as varnish, emulsion, or gum arabic

Blister: separation between layers appearing as an enclosed, raised area

Brittleness (also called embrittlement): loss of flexibility causing paper to break or disintegrate when bent

Chalking: loss of a paint or emulsion layer by powdering off

Cockling: buckling or waving of the paper caused by expansion and contraction under changing atmospheric conditions

Crack: visible break in the surface, occurring when paper is creased or embossed

Crease (also called fold): line or mark made by, or as if by, folding

Dent, Dig, Gouge: defect in the surface, caused by a blow; a dent is a simple concavity, a dig implies that some material has been displaced, and a gouge, that material has been scooped out

Deterioration: breakdown of the paper caused by ingredients added during the manufacturing process or by natural aging; can yield volatile acid products

Discoloration: changes in color, such as darkening or fading

Dog-ear: term commonly used to describe a diagonal crease across the corner of a page

Fading: discoloration seen as loss of color and sometimes with a change of hue

Flaking (also called flaked loss): lifting and sometimes loss of flat areas of the surface layer

Foxing: brown or reddish-brown spots probably caused by mold or the oxidation of iron particles in the paper support, mount, or backing

Insect damage: damage caused by insect invasion, such as holes, surface loss, or organic residue

Loss: missing area or hole

Mildew: group of small fungi that grow under warm, moist conditions on organic substances causing the breakdown of those substances; sometimes apparent as foxing; detectable only by a characteristic musty odor in early stages; appear as weblike outgrowths on the surface in the most advanced stages

Mount: paper or other heavy board to which certain works on paper are attached for the purpose of extra support

Soil: dirty material either loosely distributed on the surface of an object (dust) or firmly ingrained in the surface (grime)

Support: the paper itself on which a design is executed

Tear: linear break in the paper resulting from tension or torsion

H. CURATORIAL CARE CHECKLIST FOR PAPER OBJECTS

This checklist is designed to summarize the preservation approach to caring for paper objects in the museum collection.

1. Is the environment under control: relative humidity, temperature, light, and air quality?

2. Is an Integrated Pest Management Program implemented?

3. Is the environmental monitoring and control equipment functioning properly?

4. Does the park curatorial staff have a good working relationship with the park maintenance staff?

5. Are housekeeping practices appropriate and adequate?

6. Is each object housed in the most appropriate format?

7. Is each object housed in the appropriate materials?

8. Are objects segregated by the size of the enclosure?

9. Do the housing enclosures adequately support the objects?

10. Does the museum storage equipment adequately support the housing enclosures?

11. Are handling procedures adequate to protect the objects?

12. Are objects being exhibited under appropriate conditions: in safe housings and in a controlled environment?

13. Is it appropriate to consult a paper conservator (e.g., for a site survey, for a Collection Condition Survey, for conservation treatment)?

14. Does the park's Emergency Management Plan include detailed actions to be taken in the event of an emergency situation, including the potential need to blast freeze water-damaged objects?

I. SELECTED BIBLIOGRAPHY

Alper, Diana
1990 "How to Flatten Folded or Rolled Paper Documents," NPS Conserve O Gram, 13/4, Washington, D. C.: National Park Service, Curatorial Services Division.

Barrow, W. J.
1972 Manuscripts and Documents: Their Deterioration and Restoration. Charlottesville: University Press of Virginia. Second edition, second printing.

Barton, John P. and Johanna G. Wellheiser
1985 An Ounce of Prevention - A Handbook on Disaster Congingency Planning for Archives, Libraries, and Record Centers. Toronto: Toronto Area Archivists Group.

Blank, Sharon
1990 "An Introduction to Plastics and Rubbers in Collections," Studies in Conservation (May), 35:2.

Canadian Conservation Institute
1983 Canadian Conservation Institute (CCI/ICC)) Notes 11/1, "Protective Enclosures for Books and Paper Artifacts."

1986 Canadian Conservation Institute (CCI/ICC) Notes 11/2, "Storing Works on Paper."

1986 Canadian Conservation Institute (CCI/ICC) Notes 11/3, "Glazing Materials for Framing Works on Paper."

1986 Canadian Conservation Institute (CCI/ICC) Notes 11/4, "Wheat Starch Paste."

1986 Canadian Conservation Institute (CCI/ICC) Notes 11/5, "Matting Works on Paper."

1989 Canadian Conservation Institute (CCI/ICC) Notes 17/1, "The Beilstein Test: A Simple Test to Screen Organic and Polymeric Materials for the Presence of Chlorine." Ottawa, Canada: Canadian Conservation Institute

The Canadian Conservation Institute (CCI/ICC) Notes are available from:

Canadian Conservation Institute
1030 Innes
Ottawa, Canada
KIA OC8
(613) 998-3721

Clapp, Anne F.
1987 Curatorial Care of Works of Art on Paper. New York: Nick Lyons Books.

Cohn, Marjorie B.
1977 Wash and Gouache. A Study of the Development of the Materials of Watercolor. Cambridge: The Center for Conservation and Technical Studies, Fogg Art Museum and the Foundation of the American Institute for Conservation.

Dolloff, Francis W. and Perkinson, Roy L.
1979 How to Care for Works of Art on Paper (Third Edition). Boston, MA: Boston Museum of Fine Arts.

Ellis, Margorate Holben
1987 The Care of Prints and Drawings. Nashville, TN: The American Association for State and Local History Press.

Gaehds, Christa M.
1965 "The Care and Conservation of Fine Prints". Ch. VII (pp. 99-177) of A Guide to the Collecting and care of Original Prints, by Carl Zigrosser and Christa M. Gaehds. New York: Crown Publishers, Inc.

Hatchfield, Pamela B. and Jane M. Carpenter
1986 "The Problem of Formaldehyde in Museum Collections". The International Journal of Museum Management and Curatorship (1986), 5:183-188.

1987 Formaldehyde: How great is the danger to museum collections? Cambridge: the Center for Conservation and Technical Studies, Harvard University Art Museums.

Hunter, Dard
1978 Papermaking: The History and Technique of an Ancient Craft. New York: Dover Publications, Inc. An unabridged republication of the second edition of the work as published by Alfred A. Knopf, New York, in 1947, Chapters VI, VIII, XIII, XIV, and XVII.

Jordan, Anne
1990 "Exhibit Mounting Variations for Objects on Paper," NPS Conserve O Gram 13/7. Washington, D. C.: National Park Service, Curatorial Services Division.

__________.
1987 "Archives: Preservation Through Photocopying," NPS Conserve O Gram 21/3. Washington, D. C.: National Park Service, Curatorial Services Division.

__________.
1988 "Archives: Reference Photocopying," NPS Conserve O Gram 21/6. Washington, D. C.: National Park Service, Curatorial Services Division.

Jordan, Anne and Newman, Jerri
1987 "Removing Original Fasteners from Archival Documents," NPS Conserve O Gram 21/4. Washington, D. C.: National Park Service, Curatorial Services Division.

__________.
1987 "Attachments for Multi-page Historic Documents," NPS Conserve O gram 21/5. Washington, D. C.: National Park Service, Curatorial Services Division.

Library of Congress
Publications on conservation include Boxes for the Protection of Rare Books, Matting and Hinging Works of Art on Paper, Polyester Film Encapsulation, Preservation Leaflets, Procedures for Salvage of Water-Damaged Library Materials. Some distributed free by the National Preservation Program Office, Library of Congress, Washington, DC 20540.

Munro, Susan
1980 "Conservation Framing," NPS Conserve O Gram 13/1. Washington, D. C.: National Park Service.

__________.
1980 "Framing Valuable Papers," NPS Conserve O Gram 13/5. Washington, D. C.: National Park Service.

__________.
1981 "Mylar Encapsulation," NPS Conserve O Gram 13/6. Washington, D. C.: National Park Service.

Ritzenthaler, Mary Lynn
1983 Archives and Manuscripts: Conservation. A Manual on Physical Care and Management. (SAA Basic Manual Series) Chicago: Society of American Archivists.

Sandwith, Hermoine and Stainton, Sheila
1984 The National Trust Manual of Housekeeping, Chapter 2. "Books and Documents," pp.27-47. London: Allen Lane, Penguin Books, Ltd.

Weidner, Marilyn
1967 "Damage and Deterioration of Art on Paper Due to Ignorance and the Use of Faulty Materials". Studies in Conservation, 12:5-24.

J. ENDNOTES

1. Based on the form included in the "Jefferson National Expansion Memorial Archives Master Plan" (March 1988) written by Harry G. Heiss, Archivist, Jefferson National Expansion Memorial NHS.

APPENDIX K. CURATORIAL CARE OF TEXTILE OBJECTS

APPENDIX K. CURATORIAL CARE OF TEXTILE OBJECTS

A. INTRODUCTION

The history of fibers and their manipulation into utilitarian and decorative fabrics goes back to the Stone Age. It is thought that fiber manipulation in the form of weaving may predate spinning of fibers. Long plant fibers were intertwined and woven into baskets, mats and protective garments; this type of basketwork formed the basis for many types of weaving.

The development of spinning enabled more types of fibers to be used. Wool, and much later the short fibers of cotton, could be controlled and twisted together into long threads. Using elements of the same basic spinning technique, the resulting threads could be twisted together or plied. The twist of both the single and plied threads yielded stronger threads and yarns that could withstand the increased handling and stress required by further developed methods of fabrication, such as knitting, stitching, knotting, netting, lace, and more complex weaves.

Decoration of textile materials can occur at all stages of fabrication. Dyes, stains and pigments have been used to add color to fibers, threads, and fabric. Surface design and embellishment have been used, e.g., embroidery, applique, printing, and patterning with beads, bone, sequins, metal threads, etc. Fabrics and materials have been joined by various techniques for both structure and design in costume, banners and flags, quilts, furnishing fabrics, and upholstery.

The term "textile" covers a broad spectrum of unrelated objects. All methods of textile fabrication and design have been used throughout the world. Different geographical cultures developed different techniques, design, and decoration depending upon availability of the raw materials, direction of development of their culture, and the general political and economic environment at the time the piece was executed. North American textile collections include a wide variety of all of the techniques. Most of those that come under the care of museums, galleries, and historical sites in this country can be roughly divided into four categories:

1. Textiles of very early civilizations found and recovered through the archaeological study of sites.

2. The relatively more recent native American pieces that have been part of the ethnographic and cultural study of our nation's heritage.

3. Textiles introduced to this country with the early settlements and colonization and including all that have since developed within America.

4. Special collections of European and non-Western Textiles that have been assembled and are instrumental for the study and understanding of the history and development of textiles, costume, and art.

This Appendix addresses issues relevant to the care and background information associated with the last two categories listed above. The guidelines for the approach to and handling of textiles cover issues needed to successfully care for mixed collections of tapestries, carpets/rugs, furnishing fabrics, upholstered furniture, banners and flags, embroideries, canvas work, costume and accessories. It addresses traditional museum problems as well as those peculiar to historic sites and houses. Archaeological and ethnographic materials are not discussed specifically, although many of the same principles of care prevail.

B. THE NATURE OF TEXTILE OBJECTS

Textiles are composites of fibers, fabric, finishes, and embellishments that enhance design. It is not possible to cover all of the materials that have been associated with and are integral to textiles. Careful visual examination may identify common elements or classifications of elements. If some of the important properties of these components are understood, then evidence of their deterioration can help to determine handling procedures and facilitate decisions regarding the control of collections.

The following is a brief introduction to fibers, fiber manipulation to construct a fabric or cloth, fabric finishes used to affect the appearance or handle of the cloth, and embellishments to create or enhance design.

1. Fibers

Prior to the 20th century, natural fibers were the only source materials used for fabricating textiles. The development from the use of furs and skins to the manipulation of fibers varies depending upon the needs of the source culture. There are many types of natural fibers that divide basically into two main categories, animal and vegetable. The animal fibers consist predominantly of hairs, wool, and silk while the vegetable fibers come from the stem, leaf, and seed portion of plants. All can be separated, cleaned and twisted together to form threads which are then manipulated to form cloth. None of these materials was originally meant to be used for cloth. It is man's invention that manipulated these fibers into the variety of textiles that are in collections. These processes cause stress, strain, and damage to the original fibers in order to produce textiles with certain desirable properties and characteristics.

Wool, silk, cotton, and flax have proven to be those fibers most often discussed and which have developed to be the most suitable for textiles. The basic molecular and cellular structure and shape of these fibers, along with spin, fabric structure, finishes, and after-treatments affect the characteristic properties of the resultant cloth.

a. Animal Fibers

Animal fibers are made up of basic chain-like protein molecules. The complex and convoluted arrangement of these molecules determines the nature of the protein fibers and their basic characteristics and properties, e.g. the elasticity particular to wool.

Hairs (all animal-covering fibers other than wool) are usually long and coarse, originating from the outer coat of an animal. They are found in textiles, but are most often used as associated materials i.e. horsehair padding, filling for furnishings, or felt made from rabbit fur.

Wool is the undercoat of the sheep and the term is often restricted to the unique covering of this animal. The healthy growth of fibers is sheared from the live sheep. The breed and health of the animal, as well as the shearing and cleaning processes used all affect the final product. The elasticity of the fibers as well as a unique characteristic referred to as "crimp" are inherent in the various breeds. Crimp allows fibers to cling tenaciously to one another, requiring less twist for a strong, loosely spun yarn for knitting. Generally, longer fibers need less twist than short fibers and they are often resilient, have luster, and wear well when used for carpets, suiting, and tapestries. Wool is considered to be hygroscopic: it can adjust its water content by absorbing and yielding moisture readily, depending upon atmospheric conditions. Because of this, it is not resistant to environmental conditions.

Silk is also a protein fiber. It is the only natural fiber of importance that is recovered in the form of a continuous filament. This filament originates from the cocoons of the silkworm and is harvested by a method called reeling. It has a rigid and highly-oriented molecular structure and, unlike wool, does not have the same benefit, i.e. the property of elasticity. The silk fiber combines high strength, flexibility, and moisture absorption. It has a soft, warm, and luxurious appearance. It is used to make the lightest, sheerest chiffons and the richest heavy pile velvets. It is treated with various finishes to enhance its natural characteristics, the most important of which are weighting agents of various materials to add body and weight to the fabric. The deleterious effects of these finishes will be discussed later.

Silk is tedious to produce and subject to hazards of the industry. Short fiber waste silk is a result of these hazards. This "waste" is further cleaned and processed and also used for textiles in all forms of velvets, piles, scarves, ties, fabrics, knitted goods, lace, and woven blends.

b. Vegetable

Cellulose forms the basic molecular material for vegetable fibers. They are rigid in structure with fairly regular chemical groups that attract water. When water is absorbed, the fiber is loosened, more flexible, and not as inclined to break. The vegetable fibers originate from the bast (stem), leaves, or seeds of a growing plant. The relevant part of the plant is harvested and the fibers are separated, cleaned, and processed for spinning and use in making cloth; all of which affect the final product.

The most commonly discussed bast fiber is flax, which is spun into linen thread. The long fibers from the inner bark are released from the harvested stems by retting, a process of controlled natural decomposition. The deteriorated strands are then

separated by harsh mechanical processing. The resultant fibers are harder than some of the other vegetable fibers and are strong, though not very elastic. The quality depends upon the growth conditions, as well as how clean the resulting fibers are from debris and impurities. The basic structure and characteristics of the cells and fibers make new linen thread strong when wet, resistant to heat, sensitive to deterioration by exposure to light, and difficult to bleach or dye to concentrated colors.

Leaf fibers are hard and strong. They are usually used for rope, cords, and baskets. Some examples that may be identified in collections are sisal, hennequin, abaca, and raffia.

Seeds or fruits are often attached to hairy cellulosic fibers. Some examples are coir (coconut fibers), kapok (often used in upholstery), and the most common to our everyday use, cotton. Cotton is essentially pure cellulose. The natural purpose of cotton fibers is to accumulate moisture for the seed. Again growth conditions and type of cotton affect the nature and length of the fiber. All cottons have relatively short fibers and must be spun in a humid environment, with a great amount of twist for strength. It is relatively inelastic and affected greatly by moisture. Mercerization is a technique often used in processing cotton thread and fabric. It facilitates dyeing and adds to the softness and flexibility of the cloth.

c. Natural and Synthetic Polymers

The natural and synthetic polymers began to be developed at the end of the 19th century but were not a commercial entity until the early 20th century. They can be divided into two basic categories, natural polymers and synthetic polymers. Unlike the natural fibers, they were developed to make threads, yarn, and cloth and were often fashioned to incorporate and mimic the good features and appearance of the natural fibers.

The raw materials for natural polymers are natural substances. Cellulose or proteins are chemically solubilized and re-formed into long filaments. The most common of these natural polymers encountered in collections are rayons, cellulose acetates, triacetates, natural rubber, etc. Some of these materials have characteristics closely related to the original raw material; some have variations on these properties. There are too many variations in the production of these fibers and fabrics to be able to predict their deterioration or their reactions to use and environment. It should not be assumed that pieces made of synthetic material are stronger and hardier, needing less concern than the older or contemporary objects made of natural fibers. It is known that many of the natural polymers have not aged well and show basically the same vulnerabilities to wear, environment, and handling as do their natural raw materials.

Synthetic polymers have only been around since the 1930s. They are essentially chemically made polymers created in the laboratory and manipulated into long filaments. This category includes many plastics and synthetic rubbers. Polymer fibers include the nylons, polyesters, polyvinyls, polyurethanes, and other synthetics. These are used either as the main fabric or as support and inner layers of garments, undergarments, backings to hangings, carpets, outer finishes, and embellishments of decorative and contemporary art objects. Many of the synthetic polymers have not been around and observed long enough for us to know the overall long-term effects and vulnerabilities. With an abundance of these materials being incorporated into collections, many questions are arising about how to care for them and how to recognize problems.

d. Metallics

Another group of threads used to make and decorate cloth are the metallics. These can include any combination of metals and alloys, and backing or support materials. The metallic can be in almost any form, from a flat, pounded strip to a fine, round wire; it can be wrapped around a fiber core thread such as silk or cotton, or it can be of any variety of shapes to form texture, spangles, or beads. It can be woven into the structure of the cloth or used as embellishment and decoration on the surface. Some forms that may be encountered in all categories of textiles are the following:

- gold metal layer on silver strip
- silver metal strip containing impure metals
- small diameter metal wires; solid gold, silver, or copper metal with other metals present
- metal strip made of other kinds of metal or metal alloys
- thin sheets of precious metal (gold or gold alloy, silver or silver alloy) cut into narrow strips, or lamellae and spun around a fine linen or silk thread core
- gold, gold alloy, silver or silver alloy, or other type of metal alloy on clay-like layer over fibrous backing strip
- thin sheets of metal applied to animal membrane, leather, paper, and wound onto a core thread
- in contemporary pieces, gold powder and pigments often on a mylar or other synthetic backing

2. Fabrication

There are many fiber techniques that result in cloth or cloth-like materials. An early construction and one of the simplest is felt. Felt is the resulting interlock of loose fibers by a process that combines heat, moisture, and pressure. The best raw material is sheep wool due to its chemical structure and characteristic properties, in particular, crimp. Lacquers and sizing have been used as stiffening agents depending upon final use. Felt has been prevalent in certain cultures and its uses are varied. These same basic techniques are employed today along with new methods and use of synthetic materials developed by industry.

Spinning is the fundamental process of converting a mass of short fibers into long threads or yarns. This process has altered little since its invention. It developed in many parts of the world with many different fibers, but basically it is the same technique regardless of its source. Loose fibers are pulled out of a mass of prepared animal or vegetable fibers and are twisted to create a continuous length of yarn. These yarns can be used as is, or twisted together to make a plied yarn of greater strength. These spun and plied yarns can be converted into cloth by many methods of fabrication using single and multiple threads, either by hand or requiring tools and equipment.

Netting can be a knotless or knotted loop technique using a single continuous strand and the fingers or a simple tool called a shuttle. This also forms the basis of some lacemaking, and tatting. Knitting and crocheting are other single element methods of looping construction.

Lacemaking is an intricate twisting of several fine threads to form a pattern. There are a variety of techniques that fall under the category of lace involving basic knotting as mentioned above as well as needlelace, bobbin lace, or pillow lace with threads twisted, crossed, and plaited. In addition, there is free lace and decorated net using all combinations of twisted, crossed, plaited, and knotted structures.

Macrame uses more than one strand of yarn in an elementary knotting used mostly for fringe, macrame lace decoration of fine table linens, religious objects and ethnographic garments, horse trappings, and accessories. Braiding also incorporates several strands in an intermesh structure to give pattern and texture. This is used for all types of narrow cloths and embellishment and is related to basic weaving techniques.

Sprang is comprised of stretched parallel yarns, on a frame, twisted upon one another; there is no crosswise element except to secure the final twisted structure. The resulting fabric is extremely elastic due to the added twist. Often the design and structure is not evident unless spread out. (If the piece is old, spreading it out

can be quite damaging and if it has been mounted extended, the fibers will be fatigued and very fragile.)

Weaving is one of the oldest methods of fabrication practiced by man. It is the interlacing of a set of parallel yarns stretched on a loom and running lengthwise (warp) with a transverse element (weft) in a pattern to build up a fabric.

There are three fundamental weaves that are considered to be the basis for woven fabric construction. The simplest fabric structure is plain weave, a simple 1 over 1 interlacing of perpendicular warp and weft elements of fabric. Plain weave has been, and still is, found in all geographic regions using all materials. The second basic weave structure is twill. This produces diagonal lines in the surface of the weave. There are many variations of this weave. The third class of woven structures are the satin weaves. There is no visible diagonal direction on the cloth surface and there is a difference between the surface of the two faces of the fabric. This term, satin, often implies silk but has no concrete reference to the fiber used. It is the structure that is important in determining the characteristics of the cloth and is directly related to its ultimate use. For a detailed discussion of types of weaves, see the reference Warp and Weft by Dorothy K. Burhham listed in Section K, of this Appendix.

3. Finishes

Even with no use and history, a simple textile is rarely just processed raw fibers made into cloth. All fiber pieces have undergone processing during and after the making of the cloth in the form of weaving lubricants, mechanical and chemical finishes, chemical sizing, dyes, water and stain repellents, mothproofing, and flameprooofing. The primary objective is the appearance and hand of the fabric. This can be as simple as removing knots and pulled threads and imperfections, setting or blocking of the weave, or it might involve extreme chemical treatments to give weight, body, and color.

Cropping, napping, and shearing of the cloth raise the fibers to the fabric surface creating a soft, slightly piled fabric. Rubbing, pressing, and glazing give a smooth, lustrous surface. Variations of the latter can give calendared or moire finishes where the fibers are flattened either evenly or unevenly to give a glazed lustrous surface. These mechanical methods are sometimes combined with chemical additives like oils, gums, starches, beeswax, varnishes, pitch, and gelatins. Egg white and water or gum arabic were used on glazed woolens and linsey-woolsey blends used in bedquilts in the 18th century. These can easily be damaged by handling and environment, especially upon exposure to moisture.

Scouring and fulling range from a gentle cleaning and fiber loosening to a more drastic process resulting from moisture, heat, agitation and pressure, respectively. During the weaving process, oils, lubricants, and sizing are often used to prevent entanglement of threads and to strengthen the warp against the friction of the loom parts. These materials are usually washed out by a method of laundry called scouring. Fulling is essentially felting of a finished woven fabric. It involves shrinkage and results in softness, body, and strength. In some cultures, it is used to extremes to produce strong resistant outer environments or protection, such as tents, coats, shoes.

In reality, these methods are combinations of mechanical and chemical treatments. Fulling involves the use of lubricants and detergents and other additives including "fuller's earth," a powdery mineral substance of sedimentary clay with aluminum silicate. This is used both to absorb grease and dirt as well as for a weighting or filling agent. Historically, part of the fuller's job was also to bleach and sett the finished fabrics. After this treatment, blocking or "tentering" the fabric sets the shape and dimension of the fulled material.

Mercerization, a strongly alkaline chemical treatment for cotton threads and fabrics, swells the fibers and reduces the natural fiber twist, thus increasing the strength, durability, luster, dye receptivity, and affecting shrinkage. This is often a preparation for the dye process which is itself a strong chemical alteration of the fiber molecule.

Dyes can be introduced to fibers and fabric. Natural and synthetic dye processes can involve drastic chemical treatment. Most of the processes involve heat and composite mixtures of chemicals, some of which weaken the fibers greatly and/or make them more susceptible to the environment.

Weighting was a method used in processing silk for costume, flags and banners, and notably fringes and tassels. This method of increasing the density of the silk with metallic salts, sugar, etc. was frequently used in western cultures during the 18th and 19th centuries. The silk is boiled and the natural gum that protects the fibrils is removed. The fabric is then steeped in a weighting agent which is absorbed into the fibers. Fabrics can absorb these agents to many times their original weight; this made it a profitable property, used to full advantage for commercial reasons, especially during the 19th century when fabric was often sold by weight rather than measure. Though, when new, they have a much fuller feel and drape, weighted fabrics are not as strong as those made of pure silk. This makes the fabrics more susceptible to fracture of fibers from handling and eventually causes degradation to the stage of powdering. The crystalline metallic salts act like little knives, weakening the fabric, which can explain the unsuspected fragility of the fabrics and attachments such as tassels. Weighted fabrics, silks in

particular, are drastically affected by washing or dry cleaning. They are often more sensitive to effects of light, moisture and air pollution and show deterioration more rapidly depending upon the extent of weighting, the environment, and the damage from wear (e.g., perspiration and abrasion).

Finishing processes are also used on the new synthetic fibers as well as new synthetic finishes used on the natural fibers. The dyes, plasticizers and synthetic resins, and emulsions used for soil, crease, and water repellency, as well as mothproofing and flameproofing are too numerous to discuss. Their longevity and long-term effects on the fibers are not known. An example is a 1938 Everglaze process to produce a durable finish by combining a water solution of a synthetic resin, applied to cloth, with a chemical catalyst. The polymerization reaction occurs when heat and pressure are employed changing the chemical nature of the fabric and how it reacts to its environment. The finish was made to be "permanent." Many of these finishes are chemically active and are not immutable. The degradation products can be very hazardous to the fibers and long-term structure of the piece.

All of these processes cause irreversible damage to the fibers. This kind of damage may yield desirable properties to the fabric, e.g. softening and drapability through fracture of the harder fibers or added softness and greater dye absorption through cotton mercerization. Some of the damage may not have affected the function of the piece; however, these treatments and their effects have to be taken into consideration when trying to preserve and handle these pieces as they age and have a new role in our collections.

4. Embellishments

Fabric can be decorated by such things as dyes, patterns created during the weaving process or when joining pieces of fabric together, or by added embellishments such as applied paint/pigments/gilt, fabric, braids, stitches, metals, and beads. The decoration methods used to join pieces together are also structurally functional. There are many ways to join fabrics together employing needle-weaving, crochet, variations of the conventional embroidery stitches, and insertion of any of the types of bands and laces that can and have been produced. It is important to be aware that a decorative embroidery or other embellishment may be related and integral to the actual structure of the piece. This is important not only for general interest but also an important consideration when handling the piece. These areas are potentially weak, have been under extra stress and strain, and need extra support and care.

Another important decoration that can be either functional or decorative involves the warp end finishes of carpets, hangings, furnishings, garments, etc. These are most often recognized as simple fringes though they may be very much more complex. Fringes can be integral to the structure or added as an embellishment or a

combination of the two. This is especially important with regard to carpets and should be identified to define previous repairs and structure as well as areas of vulnerability. The fringes and warp ends are most subject to wear and damage, especially in a historic house setting where they may be in a public pathway.

Surface design has been administered by a variety of dyeing, painting, printing, stenciling, and stamping techniques. These can involve chemicals and additives used to prepare the fabric or pigments as with printer's gums used for thickening inks and dyes. They can also involve the use of nonporous adhesive substances like wax and starch, to reserve or resist the dye in the design areas. With any of these techniques, the removal of these substances is incomplete and residuals are spread throughout the piece. The fugitive nature of the dyes/pigments/inks will vary not only with date but also with geographical origin and is a major problem in caring for these objects.

Embroidery is basically decoration by stitches on ground fabric. This is usually, but not necessarily, executed on a woven fabric. All types of threads and yarns have been used and there are several other names which imply specific materials and variations of stitches, e.g. crewel-work, canvas-work, black-work, and gold- work. This construction is usually most vulnerable where the thread or yarn is stitched through the ground fabric. Sometimes this is just mechanical stress from bending and changing direction. Sometimes this can be a result of interaction of the ground fabric and the thread together, and with the environment, e.g. metallic thread or black dyed threads. Often when embroidery stitches are missing, the needle marks or the underdrawing or "pounce" lines for the pattern will be exposed and reveal the pattern. There may be enough fiber left for identification of materials and color. This can lead to important additional documentation of the piece.

Other embellishments to be aware of are beads, buttons, sequins, feathers, bone, pottery, plastics, and all other attachments that are used for surface design and decoration. Again, as with buttons, there may be a function involved. This may indicate related weakened and strained areas of a piece that are a concern when handling. Missing pieces may be indicated by remains of a thread or stitch-holes or even by changes in color or texture. Be aware that the materials of an attachment of this sort can interact with fabric finishes and dyes of the ground fabric. This is often seen in costume and may be seen as rust marks, differentially colored areas caused by both protection from fading as well as actual chemical reaction with a dye to visually produce a different color altogether. Early sequins were made of gelatin and glues were used to secure lace and trims. Gelatin and early glues are very hygroscopic and are water soluble. If there is excessive moisture, they become very vulnerable and can dissolve or become tacky. Again, the environment is very important in controlling and retarding some of these interactions.

C. THE NATURE OF TEXTILE DETERIORATION

In order to understand deterioration of textile objects, it is necessary to try to understand the physical and chemical properties of materials and their aging. Deterioration can occur at all levels. At the most basic level, it is the process by which the long chain fiber molecules are broken down into smaller chains resulting in shortened fibers and weakened intermolecular structure. The results are fragility and brittleness. This can happen throughout the entire textile or in particular areas due to uneven stress and strain, localized exposure to detrimental conditions, or biological attack. The latter leads to weak areas and often differential discoloration.

When we can see and recognize these weakened areas because of a change in optical properties such as color, surface gloss, opacity, and structural integrity, we are more aware of the damage and need for extra care. It also means, however, the damage has occurred to an extreme. **Deterioration and aging cannot be prevented, however, it is possible to slow down the process.** Recognizing the properties directly related to the causes is crucial in determining the correct care, handling, and environment for the collection.

There are four contributing factors which cause deterioration of textile objects:

- natural deterioration of the fibers, including chemical and physical instability, and interaction of incompatible materials and degradation by-products

- mechanical damage from excessive handling, poor storage and display, disaster, and vandalism

- effect of environment

- biodeterioration from insects and microbiological infestation

These individual elements act together to deteriorate and weaken the object and all must be taken into consideration when determining how to use and handle the piece.

1. Natural Deterioration (physical and chemical)

   As all materials age, they slowly break down and are in the constant process of deterioration. Natural fibers used for textile materials were not originally meant to be manipulated and made into the textile object found in collections. They were living matter with a short-lived biological function. They were collected and treated to create the particular object. The aging of this matter is a part of its life. Natural aging and reaction to environment is what is considered to be the inherent degradation of the fibers. For

example, the natural fibers are all hygroscopic to some extent. They will react dimensionally by expanding and contracting in response to moisture from the atmosphere. The degree of dimensional change depends upon the source materials and their treatment during formation of the textile. As all fibers age their physical structure changes and affects this moisture absorption. There will always be some degree of dimensional instability and there will also be a slow decrease in inherent moisture content. Change in structure can also affect the resiliency or elasticity of fibers leading to more drastic reaction to stress and strain from improper handling, and exhibit techniques. The result is less structural integrity, brittleness, and harshness to the touch. Sharp bends and folds will increasingly cause breakage and loss of fibers.

The chemical integrity and purity of the original materials can affect the aging of an object. Adulteration of the original materials (e.g., residue of natural lignins in linen) can drastically reduce the inherent stability of the textile and hasten the degradation process. The presence of small amounts of metals and their salts, particularly copper (e.g., contamination from copper pipes, dyes and mordants, metal decoration, residues) can accelerate degradation reactions, especially in the presence of oxidation agents such as bleaching agents, ozone, ultraviolet radiation, and moisture.

The physical state of an object can also play a part in the course of degradation. Coarse materials may not exhibit loss as immediately as fine materials since there are physically more fibers to be degraded. Often the damage is on the outside surface while the inside fibers have not been affected. It is a bit like metal corrosion. When damaged fibers are removed through cleaning, the inner fibers, now exposed, can be oxidized and damaged. Each successive treatment removes more and more of the fibers. This is illustrated best by the natural oxidation of cottons. The brownish overall discoloration caused by oxidation and aging of the cellulose protects the inner fibers. When washed, the discolored and degraded oxidized cellulose fibers will be lost and eventually the newly exposed fibers will be oxidized and the brown overall discoloration will be again evident.

The processing of materials and fibers can enhance their chemical instability and the chemical by-products of that instability can further accelerate the degradation of the piece. As materials chemically change upon aging, the new chemicals produced can often be a greater hazard to the object. Some of the black and yellow dyes form very reactive compounds as they are oxidized. These reactive compounds can then further react with the fibers to weaken them and enhance fiber degradation. This helps to explain why two pieces of fabric of similar date and similar history can differ greatly in their strength and integrity. For example, consider patchwork quilt covers where some patches are very sound, and some fabrics, often the browns and yellows, are very weak and fragile. Dyed or printed textiles are complex since the dye can protect as well as cause this

type of serious damage. In addition, not only can the dye affect the fiber, causing a change in behavior, but the fiber can also affect the dye.

Many pieces of costume are subject to enhanced chemical instability. Decorative elements such as metallics and beads can cause some very unexpected and striking discolorations. The hygroscopic nature of some finishes can enhance corrosion and rust of closures and decoration. The types of soils found in certain objects, such as perspiration, foodstuffs, and flaking skin can also accelerate degradation and cause weak areas that must be considered.

Painted textiles often have drying oils associated with the fabric preparation and pigments. These chemically change with the oxidation of the drying oil and oxidation of the ground fabric. The reactions are also catalyzed by the presence of metallics, e.g., copper, cobalt, chromium, and iron. Materials such as drying oils or synthetic finishes that age when in contact with uncoated fabric may release or volatilize substances which can attack materials a short distance away.

Each object must be examined for structure as well as chemical and decorative components; the structure and materials may not be the most compatible of choices. If an object is constructed of incompatible materials, it has inherently poor structure and a limited life under the best of conditions. This is often referred to as **inherent vice**.

Fashion and stable construction do not always go together. Many elaborate goldwork embroideries on wool or silk velvets with the many padding materials such as paper, horsehair, and parchment cannot take excessive handling. Degradation of the wool can accelerate the deterioration of the metallic, causing tarnishing as well as chemical deterioration of the silk embroidery and silk metallic core of the metallic threads. The sharp edges of the metallic thread can cut through the silk threads. In some cases these were to be venerable objects that even in their functional lifetime were not meant to be excessively handled. Some were elaborate and decorative extensions of originally functional items. The physical stress and strain of cut and hang as well as abrasion or sharp edges of associated pieces can be an additional hazard, particularly as the fibers age and lose their elasticity and strength.

2. <u>Mechanical Damage</u>

The term "mechanical damage" covers everything from internal stresses on the fibers due to their structure and the structure of the cloth to tears and distortion from the extreme stress of handling, disaster, and vandalism. The cutting action of dust and chemical salts on the fibers is unseen but is a real hazard to the lifetime of

the piece. The sharp edges of decoration and attachments as well as the stress of securing stitches on weak and aging material can cause irreversible damage if not taken into consideration when the pieces are stored and handled.

Surface texture is linked to susceptibility to abrasion, e.g. alteration in surface luster and smoothness. Due to the porous and hygroscopic properties of fibers, any change in these qualities involves loss of fibers and penetration of foreign materials which ultimately affects the structure of the piece. Any surface alteration is impossible to repair though it may be improved by treatment by a trained conservator.

Most textiles are not on structural supports similar to framed paintings or graphics. They rarely are able to be protected by a conventional glazed frame. Three dimensional pieces do not have the internal structural elements of most sculpture; they cannot stand alone. Though they may look sound, historic textiles do not have the structural integrity to survive unnecessary handling, abrasion, and flexing. A basic understanding of the properties and mechanics of aged fibers is necessary. The risks of damage are multiplied when the piece is large or has an unusual shape.

Painted textiles depend upon the structural soundness of the design layer. This is easily affected by flexibility and structure of the cloth support. Mechanical damage from dimensional changes or careless handling will cause cracking of the media which often extends through the structure of the cloth. The paint adhesion to support cloth is very important; flaking and loss occurs the same as on canvas paintings. Unlike canvas paintings, painted textiles such as mourning pictures, flags, and trade union banners have the painted areas next to large areas of exposed, untreated fabric (often silks). Often the painting is on both sides of a piece that has no structural support. The mechanical action of movement or dimensional instability due to changes in environment will cause severe separation and tears at the interface of the painted and unpainted fabric. Due to the often brittle nature of the silks and painted areas, minimize handling and consult a textile conservator.

These same concerns for painted textiles should be applied to textiles that have been mounted or previously conserved with adhesives. Again, adhesion to the support is very important. As the fibers and adhesive age, the relationship to the support may be tenuous or the textile may become very brittle and easily fractured. As aging occurs, depending upon the adhesive and the treatment, the shape of the object in storage or display may be set as flexibility is lost. These pieces need special consideration for planning and choosing storage and display conditions. Avoid rolled storage of any piece with paint or adhesive treatments. Surfaces of both painted and adhesive treated pieces are susceptible to abrasion, dust, discoloration, and damage from environmental fluctuations and extremes.

3. Environmental Influence

The influence of the environment is integral to the deterioration process. Even new materials exposed to heat, sunlight, and air pollution are drastically damaged. When dealing with historic textile materials, deterioration is already in progress. Light causes severe damage in a short period of time. The most obvious damage is color fading. Other effects of light are change in gloss, fiber, and finish. Fibers are at risk. For example, natural silk fibers are sensitive to light, especially when degummed and left unprotected. Some reactive dyes can accelerate the photochemical damage, and the resulting decomposition can be enhanced by the presence of these dyes.

The hygroscopic nature of fibers is decreased in some older fibers due to internal structural changes. This property can still play a major destructive role in older treated materials. Mercerization is an example of a treatment that renders the fiber more sensitive to the relative humidity of the environment. It leads to enhanced dye properties, as well as to greater fluctuation in response to changes in the environment. This fluctuation can cause mechanical stress and tension resulting in breakage and structural damage as the aged fibers and threads or yarns expand and contract within the restrictions of their twist, ply, and interlaced or knotted structures.

Dirt can be defined as anything which does not belong to the original object or which is not of historical and/or scientific value. It is a combination of materials present on the textile as a result of natural and industrial pollution. The porous nature of textiles and their greater permeability leads to an even greater influence by an improper environment. Contact with grime and pollutants and their penetration into the fiber structure results in breakdown, regardless of the quality and purity of the textile material. These soils can cut fibers and hold moisture, causing physical damage at the inter- and intra-fiber level.

Sulfur dioxide bleaches, discolors, and embrittles paper, textiles and leather (i.e., red rot). Hydrogen sulfide combines with moisture to darken lead pigments, tarnish metallics and react with finishes, accessories, and embellishments.

4. Biodeterioration

Textiles provide an excellent source of food for microbes and insects. The fibers themselves, as well as the additives such as sizing or starch paste, gelatin, and binding media for pigments all

provide a healthy habitat. Soils and debris, both in direct contact with the textile or in the surrounding area, provide for growth and proliferation of the attacking organisms.

One of the chief dangers to textiles is growth of mold and mildew. When conditions are damp and warm, mold and mildew in the air can deposit on a food source, such as textiles and basketry, and thrive. The severe damage comes from the consumption of the additive or fiber. The dark stains are actually the by-product of enzymic attack used to break down the fibers or finishes into usable nutrients for the organism. These are not just irreversible stains on the fibers, but an actual biodegradation of the fibers with resulting fiber loss. Again this is a direct attack on, and weakening of, the structure of the textile. If the attack is severe, there is little chance for amelioration of the discolored area by a conservator, but the piece is not necessarily lost.

The presence of high protein material in waste hair, fur, feathers, and skins attracts as well as sustains insects that can attack textile collections. Silverfish, cockroaches, termites, and woodworms eat cellulose. They can invade basketry and hard fiber accessories (hats), as well as graze on parchment, leather, paper, fabrics, glues, and painted decoration. Woodworm, termite, and carpet beetle damage is found in furniture and associated furnishing fabrics, upholstery, and the inner structure of upholstery materials.

The most common textile pest is the clothes moth. Accounts by the Elizabethans have implied that moths were well known to attack wool, silk, and leather. Two of the most common clothes moths are the case bearer and webbing clothes moth. These are small, buff color moths that crush to a fine powder under any pressure. They prefer the dark, and unlike the common moth, retreat from light. There are about 50 very small ivory-white eggs per female usually laid in groups on the top of fabrics, or between strands of wool, at the base of hairs on furs, and on feathers. The eggs hatch and feed on the dry textile material. They seek out animal fibers and the larvae take on the color of the materials consumed making them difficult to see. The case bearer larva essentially builds a "case" or tube around it from the fibers and debris available during feeding. The web larva creates a fine web of this debris which is less conspicuous on the textile but leaves the larvae more conspicuous to predators such as the spider. The moth seen flying is probably the male. The female is usually full of eggs and rarely flies but nestles deeper into folds or fibers if exposed. Time spent eradicating the flying moths is lost time and has little affect on the problem at hand.

The damage caused to the textiles from the all of the insects is most often damage to the internal structure. Though some "grazing" on the surface of wools and silks and especially leathers is evident, most of the damage is not easily detected. Channelling causes weak areas that may not show until handled, even with careful and cautious hands.

The complete adaptation of the moths as well as the introduction of central heating has helped to keep them in our lives. Their food is not confined to just wool and fur as commonly thought. They prefer sweat, foodstuffs, and soils but can adapt to live on clean materials and synthetics if the right fats, vitamins, amino acids, and sulfur content are available. They digest the fibrous proteins in wool, hair and leather. Half of the fabric consumed by the larvae is used and the other half is debris which is the evidence of attack that we can see on the textile. The larvae absorb water directly from the environment and can control their metabolism and life cycle based on the moisture and food available. They may eat their way through unlikely materials to get at the particular food source that is attracting them. Adhesives such as high-protein animal glues can also provide a nutrient source and they may eat through a fabric to get to the adhesive.

D. PREVENTIVE CONSERVATION: ENVIRONMENT, PESTS, AND HANDLING

Preventive care of textile collections is very important. Proper storage and handling as well as careful selection of stable pieces can greatly affect the time involved in preparation of a special exhibit or periodic change in a permanent exhibition site. Improper textile display or storage can be especially hazardous and can create long-term or irreversible problems. Concentrate on preventing damage. Conservation of damaged pieces is expensive, can take months or years and can rarely reverse the damage.

1. Environment

a. Light

Light is one of the most hazardous, and often most misunderstood, factors affecting sensitive materials such as textiles. It irreversibly fades works of art that rely on dyes and pigments for their design. The damage is not stopped by using subdued visible light or removing all source of light. Degradation of the fibers as well as the colorants are still affected. Darkness retards the process but does not recover or rejuvenate the object.

Light levels should be kept to a maximum of 50 lux or 5 foot candles as measured by an approved and properly calibrated light meter. Since UV is most often measured as a proportion, measurement of UV should be done once the proper visible light level is established. The maximum acceptable level is 75 uW/lumen.

The human eye is a poor judge of light quantity because it and the mind adapt so easily to changes in intensity and reflectance. The prescribed light levels may seem low but are, in fact, similar to the available lighting contemporary with many of the pieces in the collections. If the ambient light levels in the exhibition space are kept low, the visitor becomes accustomed to it and often appreciates the care and preservation given to the collection. Use appropriate signs and educate visitors about the need to maintain this aspect of the environment for the preservation of the collection they are enjoying.

Never exhibit sensitive materials in sunlight or direct daylight from a window or skylight. To minimize photochemical degradation resulting in discoloration, embrittlement, and fading of dyes and pigments, ultra-violet (UV) exposure must be limited. Elimination of all wavelengths below 360 nm is recommended. Some UV, 360-400 nm, is needed for proper color rendering. Use UV filtering barriers over UV emitting light fixtures such as fluorescent tubes. Use UV filtering plexiglas for framed objects and display cases when possible.

Limit the time of exposure as well as the parameters of light. Textiles are sensitive materials and are not suitable for permanent or extended periods of exhibition. Objects can be removed to safe storage and exhibited periodically to extend their usefulness and role in the collection. Most collections are able to exhibit substitute pieces. Use of conscientious reproductions might be acceptable. Especially fragile pieces could be subject to view by appointment only or be lit only during well defined hours. There are many methods of controlling exposure including dimmer switches, curtain and blinds, or time lag switches that can be drawn or activated at visitor request.

Case lighting should incorporate filters and diffusers to spread the light uniformly over a piece. Due to generation of heat, lighting should never be inside a small unventilated case. **Spotlights can create hot spots of light and heat.** Keep these lights at a distance and make an effort to create uniform lighting. Be aware that heat generated by spotlights can disturb other systems such as humidistats and alarms.

It is acceptable that objects be exposed to higher light levels during work on exhibit installation, conservation, study, and research. This is required for safe handling and prevention of unnecessary damage within the role of the textile as a historical and artistic object in a museum collection or historic site.

b. Relative Humidity and Temperature

Textile materials should be kept between 50%-55% RH. This is the optimum RH and with some mixed collections, composite pieces, and in some buildings and sites, this is very difficult to maintain. **Excessive dryness below 45% RH can cause brittleness and fracture of fibers.** Heat increases aging and lowers RH. **High humidity, 65% and above, promotes biodeterioration from microbial growth and infestation.** Never store materials in cold, damp environments. The resulting damage cannot be reversed. Portable humidifiers and dehumidifiers can be used to assist with climate control during extremes of seasons or in case of a disastrous leak or flood.

Relatively rapid fluctuations cause the most severe damage. Try to match storage and site environment as much as physically possible. Do not bring materials from cold storage sites into warm exhibition areas and vice versa. If this is not possible, try to slowly acclimate objects to their new environment to prevent stress from rapid change. **Maintenance of a stable RH, as long as it is within an acceptable range, is more important than trying to attain an "ideal" that inflicts fluctuation on pieces.** This is especially important on objects that are travelling or on loan. Take note of their storage environment as it relates to the exhibition and transit environments.

Do not frame a textile in direct contact with glass. Incorporate spacers or matboard into the framing procedure. Drafts across the glass can create a moist microclimate which can cause distortion, adhesion of fibers to the glass, and promote mold and mildew growth. **Beware of the hazard created by display on cold, damp outside walls.** If there is a piece displayed on an outside wall, make sure there is sufficient air space behind the piece to keep it from direct contact with the wall. **Regularly check and maintain all plumbing for leaks inside walls and near any storage or exhibit areas.**

Monitoring equipment or indicator cards can record or be read periodically for a record of the relative humidity (RH) and temperature in the exhibit and storage areas. Variations in temperature and RH are closely related. These are subject to fluctuation created by varying number of visitors, climate, seasons, and media coverage (exposure to heat from photographic lighting, crews, and equipment).

c. Air Pollutants (chemical and soils)

Urban areas are detrimental to sensitive materials due to industrial pollution. Even some rural areas are not immune to this deleterious aspect of our environment.

Pollen, dust, and airborne particulates are a hazard to textile materials. These soils can cut fibers and hold moisture causing physical damage at the interfiber level. **The best prevention of particulate damage is good housekeeping.** Use a vacuum (see Section L of this appendix for list of vacuums) rather than moving dust into the air with brooms and brushes. Isolate objects in storage. **Cover and guard against dust as much as possible through simple mechanical means of closing shutters and sealing window cracks in storage areas.** Some of these measures can also be effective against gaseous pollutants. **Keep shop and construction work areas well away from storage areas. Minimize unnecessary traffic patterns near the storage areas and do not use storage rooms as preparation rooms and work areas. Periodic washing of dust covers and drop cloths is essential. Replace filters on air and heating vents regularly and often, especially during busy tourist seasons. Be aware of air vents and intake grates when designing display, especially open display.**

The only inhibitor of outside air pollution is air filtration and conditioning. Properly maintain the system and equipment available.

Be aware of construction materials and supplies used for storage and display and the hazards that might be involved. Damaging fumes and vapors from inappropriate materials can cause irreversible and unnecessary damage. It is difficult for qualitative research to keep up with the development of these

synthetics, adhesives, plastics, paint solvents, and resins. **Be aware that many of these materials have not been on the market long enough to know what long-term effect they will have on textiles or any other objects.** Museum requirements are much more stringent with regard to this type of pollution than the manufacturer's target market. **Research literature and other sources to determine what the best material would be for your purpose.**

2. Pests

The best preventive measure against infestation is good housekeeping. General cleanliness and regular inspection, as well as a good recording of sightings of insect or insect debris, is crucial to any sort of pest management system. All park staff can be integral to the systematic preventive measures as well as identification of a problem object or area.

Understanding the life cycles and habits of the insects as well as the other habits of insects not directly associated with damage to textiles can help in effective preservation. For example, spiders are not known to attack textile materials but the presence of a spider in a storage area is an indication that there may be an infestation, since they prey on other insects that could be damaging to textile material.

Infestation starts with the initial entrance of the insect into the collection. Flowers, plants, and potting soils are especially good sources for introducing an insect problem to the site. Textiles that come into the collections may be infested and should be isolated and examined before introducing them into the collection storage and display areas.

If infestation of an object already in the collection is suspected, isolate that object. Inspect the area to see if the particular object is the primary source of the infestation or if it is secondarily infested. Likely sources to investigate are beneath the floor boards, inside a cushion or under a carpet, carpet underlay, or upholstered furniture. Bird and rodent nests under eaves, in attics, or between walls can also be the source. The originally suspected piece can be treated but if the primary source is not eradicated, that object and other objects will be at definite risk.

Treatment of an individual piece will depend upon the extent of damage. Thoroughly vacuum the piece through screen mesh. This will remove debris and disrupt surface eggs. However, the problem with textiles is that eggs can become embedded in fibers and protected from the disruption by a vacuum source. **Consult with a conservator to determine further treatment, especially if there is structural damage.**

Mothproofing is a process that chemically alters the structure of the wool. It is usually done to the raw material at fabrication. This is a different method of protection than insecticides. **Never attempt to apply insecticides or biocides directly onto any textiles.** These materials are extremely hazardous to the object. Residue left on the object can, over time, provide a toxic hazard to those who subsequently handle the object, producing chronic effects. Arsenic and cyanide are past methods of fumigation that were used with textiles and natural history, furs, hats, and hat decorations. High levels of ethylene oxide and methyl bromide are associated with more recent fumigation methods. These materials, as well as **any form of fumigation, are not to be used by anyone not having proper training and expertise.** Future research may provide safer fumigants, but until then prevention-through-inspection and good housekeeping are the best methods to safeguard textile collections.

Mold and mildew are a chief danger to textiles. Air conditioning helps to control the large amounts of airborne spores. Dehumidification and use of other methods to control the relative humidity of the storage and display areas, e.g., silica gel in cases, are effective in preventing growth. Air circulation is also essential to help prevent a stagnant environment which promotes biodeterioration. **Never leave textile materials in a closed up room or house for extended periods of time without providing some means of circulation and environmental control.** If the proper environment cannot be controlled during off season, remove all objects to a proper storage area.

Regular examination and monitoring of the collections in storage as well as those on exhibition is the best way to provide overall care for the collection. Vigilant housekeeping and environmental control are the best preventive measures.

3. Handling

Textiles suffer from their familiarity as decorative, and often functional, objects. They were, for the most part, made to be worn or handled. Their texture and interpretation lead to the natural inclination of the public to touch and feel the materials. These objects are now esteemed artifacts appreciated for their role in our history. An awareness of their role in the museum, historic house, or site, which is not the same as their original function, must be realized by staff and conveyed to the public.

If any object is to persist, extreme care must be taken during everyday handling. Conscientious and appropriate handling requires close attention to detail.

a. **Every object should be treated as fragile and delicate.** The nature and previous function of many of the textiles in historic collections often lead to a false sense of their being robust and strong.

b. **When handling textiles, be aware of any jewelry, badges, belt buckles, and watches and the potential damage they may cause.** Remove these when handling textiles, especially during installation and storage operations.

c. **Keep potentially damaging objects, such as tools, inks, and writing materials safely away from the textile. Pens and inks should not be allowed around any textiles for any reason.** Use pencil but do not put it on the work surface and be aware of the mechanical damage it can cause.

d. **Smoke is hazardous to the fibers and due to the porosity of the basic materials, permeates the textile.** Do not allow smoking near the collections.

e. **Adhesives or commercial quick-stick products (e.g., pressure sensitive tapes, gummed brown wrapping tape, rubber cement, glues or heat sealing mounting tissue) should not be used in direct contact with a textile or in closed environments like vitrines or display cases.** Adhesives can penetrate the fibers and degrade, attract dust and dirt, discolor, and volatilize reactive substances into the enclosed environment. The damage from these substances is irreversible and can seriously damage the physical and chemical integrity of the object and, therefore, the value of the textile.

f. **Keep hands away from a piece unless handling is necessary.** The body gives off acids and oils through its pores. Just as this is evidenced on tarnished metals and sensitive photographic finishes, textiles are also chemically affected. Wash hands often and use clean, white cotton photographic gloves. Remember, the textile is no stronger because it is being handled with gloves. It still must be treated as the fragile textile it is. (The friction of the cotton can sometimes cause greater fiber loss and damage. The decision to use gloves, especially during installation of exhibits, must be made with regard to the situation, the experience of the handler, and the individual piece.)

g. **Never touch or drag anything across the surface of a textile. Never stack pieces directly on top of each other;** use acid-free tissue interleaved between pieces and be aware of the weight and fragile decoration of an item. Ideally, pieces should not be placed on top of one another.

h. **Seek the optimum protection for each object.** Fold pieces as little as possible. **Avoid any sharp creases and severe stresses that can cause mechanical damage.** Pad every fold with acid-free crumpled tissue and never place anything on top of the folded object. When storing a piece, keep in mind the use of the piece for exhibition and try to fold it in such a way that it will demand a minimum of preparation and handling.

i. **Full support is essential.** Textiles rely on their basic structure for their overall integrity. They are often not protected by a glazed frame or internal support structure. Use a large enough table or several tables put together. For very large pieces, the floor may be the only support large enough to secure the whole piece.

j. **Always use a clean drop cloth or acid-free tissue between the textile and surface of the support.** This not only protects the textile from anything that may be on that surface but also provides a surface to collect important clues about the condition of the object. Insect debris, fiber loss, soils, and fragments that dislodge during handling are more obvious and easier to isolate for later analysis on such a surface.

k. **Fabrics that come in contact with any historic textile should be clean, untreated material, washed with mild, simple soap or detergent to remove warehouse and shipping soils.**

l. **Use both hands as well as the arms to support a piece, even when using an acid-free card support. See Section F.** Get help when working with large objects and communicate so that the group works together and knows where they are going and what they are doing. Costumes should be supported under the shoulders and thighs like a body with the sleeves folded over the chest. **Prevent any sharp creases and points of strain which can cause a great deal of damage in a very short period of time.**

E. PREVENTIVE CONSERVATION: STORAGE

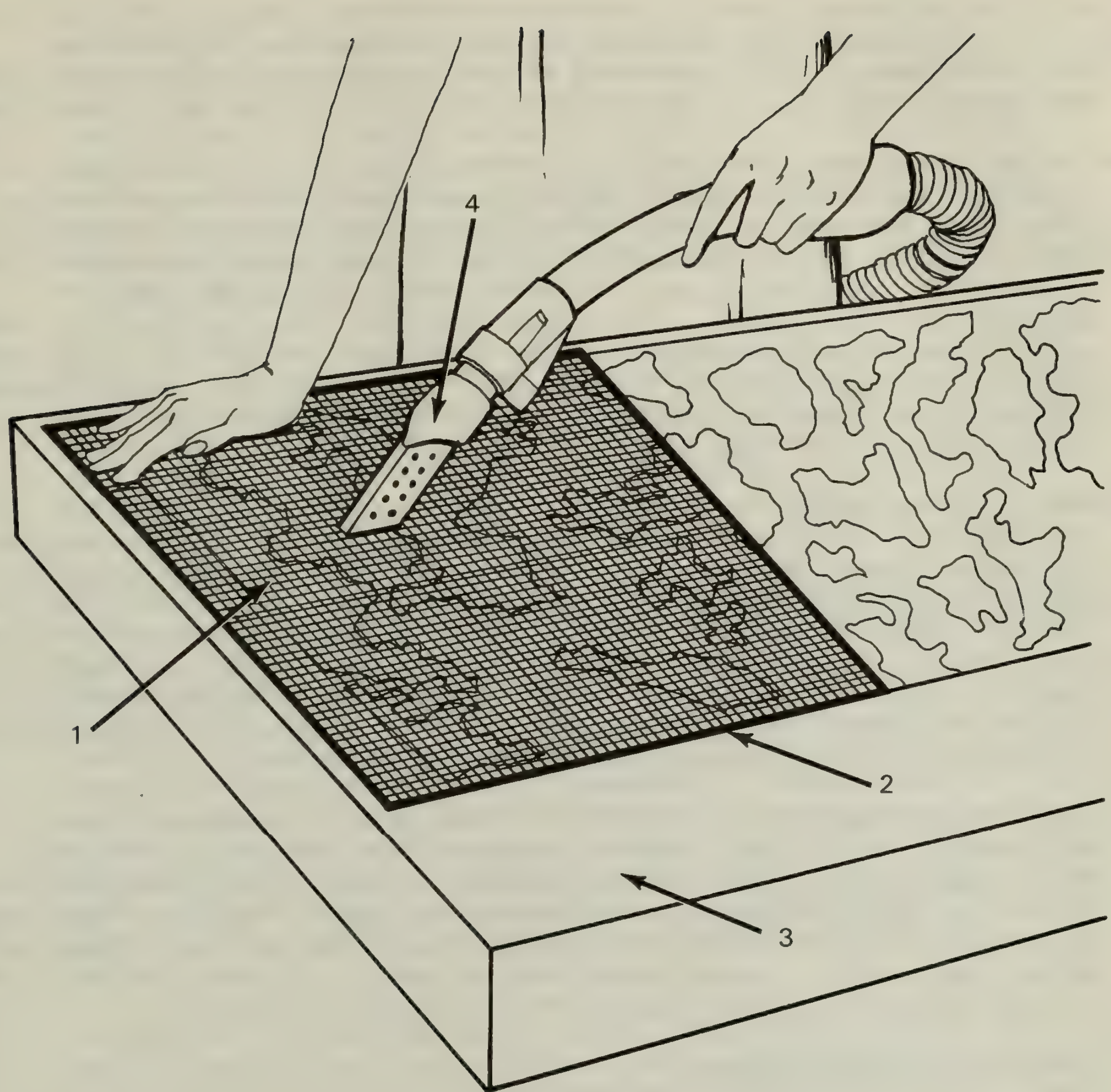
Textiles are some of the most vulnerable artifacts in the museum and their storage environment is as important, if not more important, than display conditions. The fibers, finishes, and embellishments are very sensitive to light and environment. The basic materials can provide food and nesting materials for micro-organisms, insects, birds, and rodents. Constructions are often illogical composites with regard to chemical instability or materials and physical weight. This is most evident in costume collections that reflect the trends and taste of fashion. Textiles rarely have independent structural support and are vulnerable to mechanical damage and stress and strain of hanging and drape. In addition, objects in storage are often not as easy to monitor visually as those on display where staff and visitor may notice anything suspect.

Safe storage is essential for the maintenance and care of textile collections. Achieving this goal requires constant evaluation, frequent inspection, and good housekeeping to catch problems before they develop. It involves monitoring the environment, careful planning of storage and storage systems to include safe materials of construction, and to effect easy and safe retrieval of objects.

It is important to incorporate careful description and identification of the objects. This will assist in responding to clues about the condition of the whole textile and not just the obvious superficial damage and hazards. **Damage is not always immediately evident.** Recognition of localized weak areas of the garment from wear as well as general aging, previous handling, and poor storage is particularly important.

Textiles should be stored as clean as the item will allow. Dangers from micro-organisms, insects, dust, and dirt call for regular inspection, maintenance, and general good housekeeping of the area. There are definite limitations due to facilities as well as the purpose, history, and construction of the object. <u>Any cleaning, other than surface cleaning by vacuum, should be done by a trained conservator and not undertaken without considering hazards to the textile or historical and social significance of the piece.</u>

Cleaning with vacuum should be considered part of maintenance of a collection; however it is not to be done unless necessary, i.e. preparation for storage of a piece or after open display. When using vacuum suction, there must be some way to control the amount of suction and there must be a protective barrier between the source of suction and the fragile textile. Avoid using full suction or beater bar type vacuums on any piece. The method to control the suction may be mechanical, such as a variable speed motor or it can be physical such as a slide on the hose that can be opened to allow air into the system to reduce suction when needed. Hoses with a slide feature used to release suction are essential equipment. Holes can be drilled into the sides of the upholstery/crevice wand to reduce suction. These holes can be



1. 2′ by 2′ polyethylene screen, 18-20 mesh
2. Cotton tape sewn on to cover the cut edges
3. Textile supported on a flat surface (table or floor)
4. Screen barrier between the textile and the vacuum source
5. Modified upholstery/crevice wand of the vacuum

Figure K.1. Surface Cleaning Flat Textile with a Vacuum Source

selectively covered with hand, paper, or mylar to increase the amount of suction as determined by the needs and condition of the piece. The amount of suction to be used <u>is</u> determined by the object. One can use greater suction on a structurally sound carpet or upholstered seat cushion than on a fragile silk banner or dress. If a textile is very fragile, it is best left until it can be evaluated and treated by a textile conservator.

Also, if a piece is going to a conservator for treatment, it is up to the textile conservator to determine whether and when the piece will be surface cleaned. The vacuum used on the textiles should not be used for any other purpose due to the potential for soil transfer and infestation.

The barrier between the suction and the textile is very important. All cleaning involves the loss of material and fibers. The use of the barrier diminishes the loss of fibers and eliminates the chance of ever sucking up the textile or fragile decoration such as fringe, beads, or sequins, even momentarily, into the vacuum. This is usually a piece of open polyethylene mesh screen. The screen should be clean and the edges bound with cotton blanket binding or cotton twill tape so that the sharp, cut edges of the mesh cannot cut the fragile fibers. On very fragile pieces or decorative elements, lightweight nylon net or open butter muslin can be used. These pieces require very light suction.

The screening material is placed on a section of the textile which is then vacuumed. The screen is lifted and placed on the next area to be cleaned. Never drag the screen across the fragile textile or put the screen on the end of the nozzle and drag it across the textile. This is very abrasive and will cause damage. It is better to use a small section of screen and move it often than to use a large screen that may be more difficult to carefully move and may put weight onto fragile folds and decoration. Refer to Figure K.1 for an illustration of the technique for cleaning the surface of a flat textile object with a vacuum source.

Three dimensional objects are difficult to treat. A costume is very difficult to do while it is on a mannequin. The piece should be on a fully supporting surface such as a table or floor. Care should be taken not to put pressure on folds and seams which may be fragile. Small pieces of screen, 3" x 3" work well with shoes, hats, and intricate shapes around waists and sleeves. Again, make sure the sharp, cut edges are bound with a soft cotton to protect those difficult areas from damage.

1. Flat Textile Storage

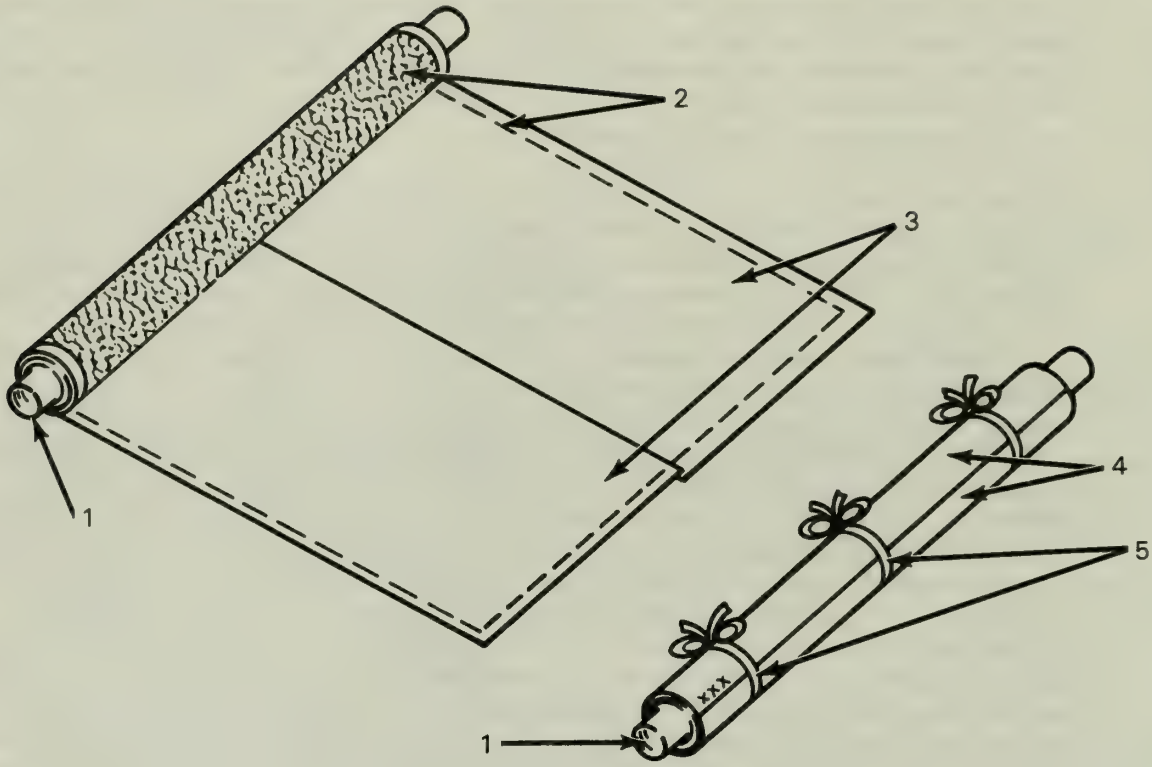
The best storage for flat textiles is to keep them flat. This is, however, only possible for small items such as samplers, small table linens, and lace. These can be stored in acid-free boxes with overlapping lids. More than one item per box could be accommodated provided they do not impair proper closure of the box and that individual pieces do not have excessively heavy decoration. They should be interleaved with acid-free tissue. This provides a barrier against the transfer of soils and dye migration. In all cases when putting more than one item per box, the heaviest item should be on the bottom. If an item has significantly raised embroidery or decoration, that item may require minimal extra padding either with a layer of polyester batt or slightly crumpled acid-free tissue.

Boxes should not be stacked in excess of two (four if the box depth is very shallow). A skeleton shelving system of storage is required

for any type of long-term box storage. Support is needed under the boxes to prevent eventual sag and no boxes should be stacked directly on the floor. Intermediate size boxes are generally suggested rather than large boxes or limiting small boxes. While necessary for some large pieces and fragile costume, large boxes are difficult to handle. The contents of an oversized box can be easily dislodged and moved around when the box is handled. This awkward size can also present a hazard to the staff handling them. The depth of the box is very important. The lid should be supported by the sides of the box, not the textile or padding materials.

It is best to try to fit an item in the box with a minimum of folding. For large flat items that cannot be stored flat, rolled storage is recommended. Refer to Canadian Conservation Institute Notes 13/3, "Rolled Storage for Textiles" listed in Section L-1b of this Appendix. The internal support should be a strong tube, preferably 3" - 4" in diameter. Acid-free card tubes would of course be ideal, but since these are very expensive, normal card tubes (available from upholstery fabric stores, newspapers, or commercial sources) may be used temporarily. This latter type of tube should be covered with polyethylene sheet, then acid-free tissue or scoured cotton. Foil could also be used as the initial cover. The foil and the polyethylene function as a barrier against the acidic material of regular card tubes. The acid-free tissue or cotton are buffers between this material and the textile. Note that polyethylene sheeting rather than plastic is recommended. Other types of plastics can be chemically harmful as they degrade. There is evidence, even with polyethylene, that in direct contact dyes can be leached from objects. For this reason, any use of polyethylene must be combined with acid-free tissue or scoured cotton (refer to section D-3k) as a barrier with no direct contact between the polyethylene and the textile.

If there is a design side and a wrong side to the textile, the textile should always be rolled so that the design side is to the outside and follows the largest circumference of that tube. Again, acid-free tissue should be interleaved the length of the textile to prevent textile-to-textile contact. This alleviates problems of soils and dye migration and, in the case of some light fabrics with decoration, diminishes imprinting from one layer to the next. This can also be important if any pieces have rust stains, blood stains, or metals and metallic corrosion. This method is essential for pieces with painted surface or detail. If there are a great deal of raised surface decoration, metal work, or metallic laces, use an appropriate layer of polyester batt wrapped in acid-free tissue to help pad these areas uniformly along the roll to give a further barrier against corrosion and moisture. Be sure the acid-free tissue is next to the textile and avoid contact between the polyester batting and the textile.



1. Rigid acid-free tube support
2. Textile with design-side facing out
3. Acid-free tissue paper or tissue covered polyester batt padding interleaved as the textile is rolled onto the tube support
4. Outer muslin or acid-free tissue cover with visible label on the outside
5. Wide cotton tapes secured every 12" with easy release bows

Figure K.2. Rolled Storage of Flat Textiles

Be very careful to roll the pieces gently without rolling them too tight avoiding any sharp folds or creases. **Never fold a piece and then roll it.** This forms a very sharp crease and, combined with the pressure of the roll, is very damaging. The support roll should be, at an extreme minimum, 1" either side longer than the widest width of the rolled textile. Always roll in the direction of the warp. The roll can then be covered with a layer of acid-free tissue and/or

scoured cotton. This rolled textile should be secured with 3/8" or wider cotton tapes in a loose tie that can be easily undone. Never tie around a textile with cording, string, or secure it in such a way that it is binding the textile or is difficult to get undone. The outer cover of acid-free tissue and/or scoured cotton should be secured at either end and gently along the width of the roll every 12" to 18". This outer cover protects against dust and dirt and can be laundered or replaced as needed. Refer to Figure K.2 for an illustration of the technique for rolled storage for flat textiles.

2. <u>Costume Storage</u>

Recommendations for storage of historic costume involves more than just how to hang a garment in a specific place. Environment, condition, and use within the context of the museum or site will determine physical storage needs to safeguard the collection. Each garment to be stored must be evaluated by the following criteria with regard to its present condition:

a. Can it withstand hanging and how (i.e., does it have a heavy, full skirt, is the fabric on the bias)?

b. What other protection does it need (e.g., garment bag, extra padding, or support)?

c. What hazards will it create for the other garments near it in the storage area (e.g., raised sharp decoration, dyes)?

Hanging storage of structurally sound garments is perfectly acceptable. In most collections, it can be the best utilization of space. It can alleviate problems of retrieval and will therefore make a collection more available and easier to use as a study collection, and for education and exhibition purposes. Hanging storage which provides adequate support and space reduces the risk of damage and reduces the amount of handling and preparation needed for exhibition.

Improper hanging storage greatly shortens the life of costume. In an overcrowded collection, many of the pieces are often supported by the costume around them on the racks rather than by their hangers. Since the hangers used are often bare wire, this condition, though not by any means acceptable, may have saved the shoulders and shoulder seams of these garments. Retrieval and handling in this state is extremely hazardous to all of the costume on the racks. Ideally, each garment should have enough room to prevent unnecessary creasing of the fabric and crushing of detail and decoration. Again, this is a matter of proper padding and care. Padded hangers will help give each item more room, but it is necessary to be constantly aware of the space problem. When newly modified storage is being considered, it is an ideal time and a unique time to find a system that can be flexible enough to accommodate the immediate needs of a collection to prevent serious damage from overcrowded conditions.

For those garments which are able to be hung, try to distribute the weight and stress over as wide a region as possible. Properly padded hangers give more cushioned natural shoulder support. Refer to The Care of Antiquities and Historical Collections and Canadian Conservation Institute Notes 13/5, "Hanging Storage Costumes" listed in Section L-2a of this Appendix. A standard padded hanger can be modified for wider shoulder support to accommodate very low necklines and can be built up around the neck for raised collars. These are made using a hanger base wrapped in polyester batt covered with clean, untreated cotton fabric. Extra padding over the hanger base gives soft, full support to the fragile shoulder area that may have been weakened by previous hanging support. Gentle support of sleeves and puffed shoulders can be accomplished with crumpled acid-free tissue paper or cotton, as needed. Note that some sleeves, though they appear puffy (e.g., leg of mutton) may have a straight internal sleeve. There is no way to additionally pad these and all that can be done is to gently smooth them and give them enough room to prevent crushing and creasing.

Sealed wood or wire hangers are preferred as the base for padded hangers. Plastics often have plasticisers that can volatilize acidic material and eventually cause damage. In preparation of the padded hanger, avoid plastics which often snap since they are usually brittle. This can either be a hazard to the person making the hanger (scratches, cuts) or if broken inside the padded structure, it can reduce support and eventually could poke a sharp edge through, and cause damage to, the garment. Rustproof metals give proper support while remaining maleable and they can be easily obtained (often clothing stores may give them away or they can be purchased cheaply through the local cleaners or donated by friends of the museum).

In addition to shoulder support, it may be necessary to distribute some of the weight of heavy, bulky skirts and alleviate the strain on the skirt/bodice seams. Refer to Canadian Conservation Institute Notes 13/5, "Hanging Storage Costumes" listed in Section L-1d of this Appendix. Wide cotton tapes (3/4" to 1") can be attached to support skirts and diminish some of the weight of the skirts of full dresses. Refer to Section L-1e for sources of cotton tapes. This is especially important for dresses with fragile bodices made of delicate materials or previously damaged at the shoulder seams. If it is a skirt with a large amount of fabric centered at the back (e.g., early 1900s walking skirts, bustle construction) bring the tapes more to that area of excess strain and spread out their front attachment to form more of a V-shaped construction. The tapes are sewn to the skirt waistband seam allowance. The intention is to take the strain off the bodice and off of the original bodice/skirt stitching. Do not use tapes when they are not necessary. The beneficial value of these tapes will have to be determined by the condition and safety of the individual piece. Tapes can also be used to secure garments with wide shoulders both by alleviating strain on

the shoulder/sleeve seams or to secure an off-the-shoulder design. Shoulder tapes placed around the neck of the hanger secure a wide shouldered garment and prevent it from falling from its support when it is either taken from the rack or the garments near it are handled. These should be used for dresses with lace shoulders to prevent the fragile lace from taking the weight of the dress. Weight due to external decoration must also be considered. When sewing on the tapes, use a wide enough tape to distribute weight, at least 1", and also consider where the weight and stress and weak areas might be.

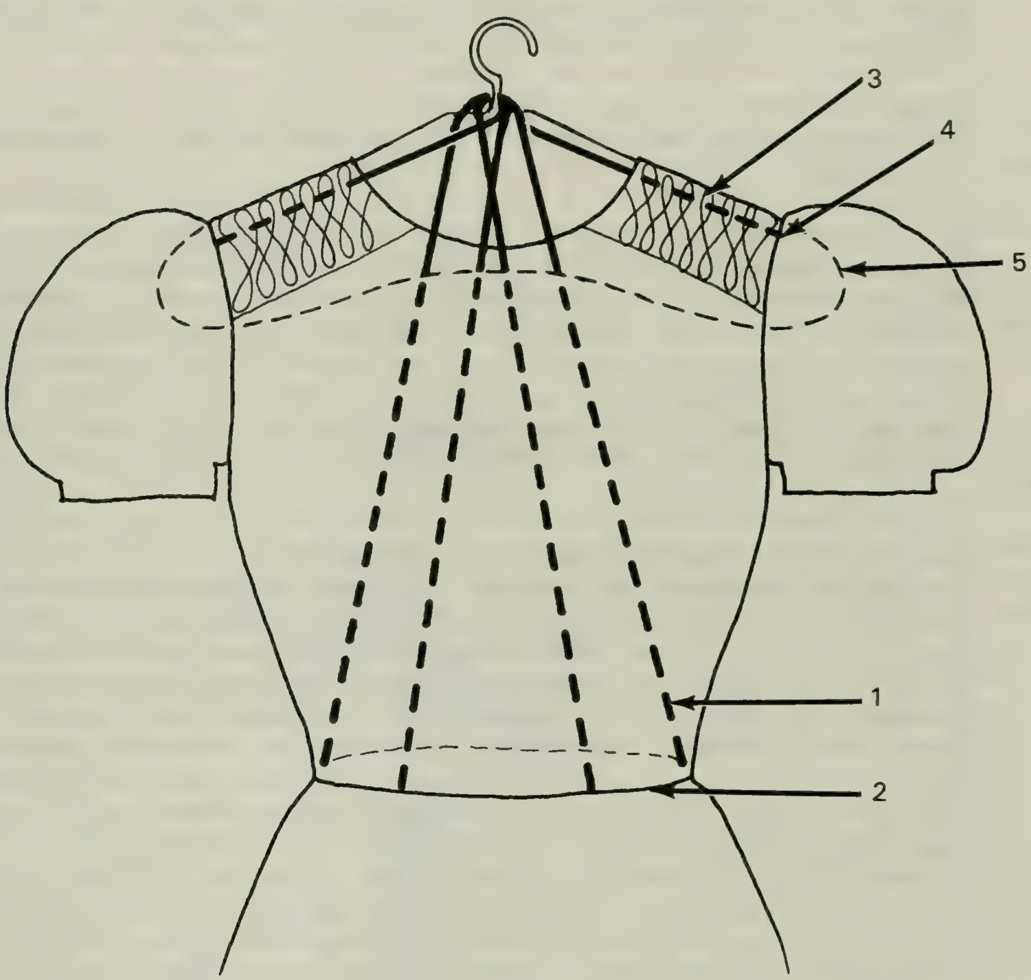
Do not make these support tapes too short or they will cause a new stress point and new damage. Figure K.3 illustrates tape supports for costume.

To secure the garments from falling off their padded supports, all closures, hooks and eyes in particular, should be secured in the wearing position. This is important to maintain the integrity of the fashion/style of the garment. It helps to prevent inappropriate stress and improper drape. Consider that the garment was not meant to be worn open and also does not hang correctly on a body if not fastened. Damage to neighboring garments can also occur if these closures are not in the closed position - especially those garments with lace and frills.

Garments should be separated by a smooth tissue to protect them from damage by a neighboring garment. This may also be necessary due to the type of damage they may cause to other garments. Military uniforms, with a great deal of metal decoration, or dresses with sharp beads, dyes, or other hazardous decoration are examples. Some garments may need further protection from additional damage or loss due to their fragile nature and construction. They may require the isolation of a cloth garment bag made of clean, unbleached muslin. The bag is also a means of protecting and preserving otherwise lost components of a garment that will later need more extensive conservation treatment. If decoration is falling off or the outer silk is shattering or fragmenting, the bag may act as a means of preserving the piece from direct handling and exposure to adverse environmental conditions as well as providing a means of collecting the pieces, beads, or decoration until a time when proper treatment can be executed. These garments require a barrier of non-abrasive acid-free tissue between the garment and the cloth of the bag. Make sure these pieces are clearly labeled "fragile" or are isolated to a special area of the collection.

A clean fabric cover for garment racks can be used to minimize dust if a closed cabinet is not available. Washed cotton sheeting can be used for simple covers to make a loose tent over the existing rack. Extra structure to support the fabric off the outer shoulders and sides of the garments would be beneficial. A central opening aids the safe retrieval of the costumes. Lift the dust cover off of the

textiles, never drag it back which will cause damage to fabric and decoration. **Do not use polyethylene sheeting since it can generate static electricity, attract dust, leach dyes, and create a hazardous microenvironment.**



1. Support tape sewn to the side front seam to support the skirt
2. Example of tape sewn closer to the center back to support a fuller heavier gathered area of the skirt
3. Damaged shoulder or fragile lace insert at the shoulder
4. Support tape sewn to sleeve/bodice seam to reduce strain on the fragile shoulder
5. Padded hanger extending safely beyond the shoulder seam for support

Figure K.3. Tape Supports for Costume

3. <u>Boxed Costume</u>

Any costume deemed not suitable for hanging storage is best stored padded-out with acid-free tissue in boxes with overlapping lids to minimize dust and dirt. Avoid any sharp creases and unnecessary folds. Some items can be contoured over rolls of crumpled acid-free tissue. Again try to prevent textile-to-textile contact. Oddly shaped or decorated items could be partially padded with crumpled or rolled acid-free tissue. Underwear and lingerie, small christening gowns, and children's clothes can be padded out and stored this way quite satisfactorily. Keep in mind the need to minimize creases and folds and textile-to-textile contact; consider protection and support for heavy or raised decoration areas from one layer to the next.

Shelved box storage is preferred over drawer storage to ensure safe retrieval of individual items, minimize dust, and provide adequate space for the object. Drawers are often overfilled and pieces get caught in the drawer mechanism or the bottom of the drawer above. A top cover to the drawer can be made to help alleviate this problem. It is also more difficult to isolate infestations in a drawer system than it is in isolated boxes with overlapping lids. Proper labeling and cross-indexing will reduce unnecessary handling of an object.

Some costume from the 1920s and 1930s in particular should be considered for boxed storage rather than hanging. This is true even if it does not appear to be in a fragile state. Often fabrics are too delicate to carry the weight of the heavy decoration and beading. Some construction is on the bias cut of the fabric in weight-bearing shoulder areas and in lower heavily decorated flounces and decoration. These should never be hung for long periods of time. These dresses, due to their usual straight cut, can easily be padded out for flat storage.

4. <u>Accessories</u>

a. Hats

Hats or bonnets should be gently stuffed to maintain shape. They are very vulnerable to crushing and are not to be stacked. Hard fiber hats such as straw boaters, and any of the leaf fibers, are extremely vulnerable to relative humidity and light. They become very brittle and are subject to deterioration and powdering. They are very difficult to reshape once they have been distorted through inappropriate storage and crushing. They are subject to destructive micro-organisms due to the nature of the unprocessed fiber constituents and the adhesives sometimes used in their construction. The fibers and elements of decoration can also provide nesting materials for small rodents. Any organism and insect that is hazardous to wood and other cellulose materials will attack these in time. Good housekeeping is an essential preventive measure.

Hats are also vulnerable to elements of their decoration. Metals can cause problems due to reaction of corrosive materials which develop from improper storage and in conjunction with residues of chemicals and materials used in hat construction. Pad decorations such as ribbons, feathers, etc., carefully with acid-free tissue to protect against accidental crushing. Supports for bows can be made from rolled lightweight mylar covered with acid-free tissue. A shelf system with a dust curtain could be used if open storage is necessary. Each hat should ideally be wrapped loosely with acid-free tissue when in open storage or in a properly labeled and cross-referenced acid-free box to minimize dust, dirt, and handling. Hats should never be stacked. When gently supporting hats, care should be taken to research their particular style so that the hat is not unnecessarily padded out of its fashionable profile.

When storing groups of these items, those hats with birds, feathers, skins, or hides should be stored in an isolated area since they may cause a particular health hazard. **Some of the taxidermied animals used for decoration should not be handled without protective gloves since the objects may contain residues of the chemicals and poisons used (e.g. arsenic).**

b. Shoes

Shoes should be gently padded; raised decoration should be protected by some means of gentle support. Crumpled tissue should be gently placed between the breast of the heel and the waist of the sole since this is a vulnerable area. Try not to handle shoes by the heels alone. A gentle way to fill out the toe area is with fluffed polyester batt wrapped in muslin while the rest of the shoe can be padded out with acid-free tissue. Be sure to support the entire shoe all the way to the back of the heel. Special attention must be made to support of the ankle section of boots. Often the body of the boot and the leg portion are sufficiently supported without adequate, uniform support of the ankle area. This does not mean for the shoe/boot to be stuffed tight. It should be uniformly and solidly supported to protect from crushing and bending at any weak areas.

For their protection as well as for the protection of the staff, boots or fragile unstable shoes should not be standing up on movable shelves or on top shelves. Pad and gently wrap the shoes and put them in covered shallow boxes, well labeled and cross referenced. Gently pack boxes to stabilize against movement of the shoes and provide the best protection from light, dust, and accidental damage.

c. Gloves, Bags, and Purses

It is a matter of gentle support for the fingers and body of the gloves and soft bags and purses to prevent creasing and crushing. Gloves in general are quite lightweight and could be boxed with several pairs to a container, provided they are properly labeled, supported, and not overcrowded. Bags and purses have the added hazard of clasps, elaborate external decoration, as well as added weight. Metals such as chains, handles, etc. should be gently wrapped to isolate them from other exposed textiles. The purpose is to protect the artifacts from damage from decoration, dye migration, dirt, and other hazards inherent in construction and later treatments (i.e. leather dressings, polishes, and metal cleaners).

d. Fans

Fans should be stored closed and wrapped in acid-free tissue. They should be packed carefully in order to avoid movement when the box is handled or the drawer is opened. The guards and blades, as well as the fabric or paper, become fragile and brittle and should be protected from mechanical damage. A good photographic documentation system of these items is very effective to minimize handling and subsequent damage.

e. Parasols, Umbrellas, and Canes

The basic problems with parasols, umbrellas, and canes are crushing and damage from sharp creasing as well as bowing and warping of the cane structure. These are often considered the most difficult accessories to accommodate for storage and display. One solution is to gently pad the folds of the umbrella or parasol with rolled cones of acid-free tissue, gently wrap the whole in acid-free tissue and then cotton. Special racks can be made to horizontally or vertically support these difficult objects. Care must be taken to support them as uniformly as possible without excessive weight on the textile portion and with enough support of the cane tip to handle. Unnecessary strain results in bowing and warping.

The mixture of materials found in these pieces also creates problems of stress and brittleness. Early pieces are often composed of whalebone and ivory and various woods. The later pieces present problems of rust and sharp metal edges as well as the bone, wood, and ivory attachments. The covers of the parasols and umbrellas are often of very fragile fractured silks and many have fragile fringes and weighty attachments which cause damage. There is no totally acceptable solution. Decisions have to be made on the condition of the individual pieces and the space, facilities, and budget at hand.

F. PREVENTIVE CONSERVATION: EXHIBIT

Display is not good for collections. Any handling, study, display, and conservation cause damage. Damage occurs slowly, it is often imperceptible with some effects more apparent than others. Color change, bleaching, and reflectance changes are easy to recognize. Cross-linking of leather, increasing loss of flexibility, and fatigue through stress and strain are less obvious until extremes occur. By the time any of these effects manifest themselves, changes are essentially irreversible.

Safe, responsible display involves control and maintenance of the environment, organization, planning, and cooperation of all personnel. It involves adequate time, space, and physical protection built into the design to ensure safe handling and installation.

It is understood that sensitive materials like textiles cannot go on permanent display without loss to the integrity of the object. Most collections are able to allow for periodic changes in display of materials. In the case of rare and fragile items, periodic display of the original rotated with display of similar substitute pieces or conscientious reproductions will preserve the original piece for future generations. Ideally, textiles should be on display only 3 to 6 months although this is often impossible. Yearly change of stable pieces is acceptable.

The museum environment is crucial to display. There are preventive guidelines; however, the addition of light and open display add increased hazard to the objects involved. Natural light is hazardous and direct contact is to be eliminated. Light levels must be controlled and UV eliminated. There are many methods of controlling light including filters, dimmer switches, curtains and blinds, and time lag switches that allow viewing at visitor request. Monitoring equipment or indicator cards can record or be periodically read for a record of the relative humidity and temperature in the exhibit areas. Be aware of the effects of the visitors on the environment of open display.

1. <u>Open Display - The Historic House</u>

   Location of objects on display is important. Lighting, ventilation, dead spots in the display site, position of air vents and air intakes, as well as outside entrances and exits are important factors to consider. Furniture should not cut into textiles; furniture cups or small discs with rounded edges should be used under heavy furniture or any furniture fitted with castors. Textiles on furniture or other objects in the exhibit should not be in direct contact with sharp corners or polished surfaces with residues that might be absorbed. Old varnishes can age and become tacky and adhere to textiles, especially under the difficult conditions of open display.

Valuable historic carpets and rugs should not be used on the floor. In a historic house, carpets can be put on the floor with a barrier of carpet paper and underlay between the floor and the textile. This helps to prevent soiling, moisture, and biological attack from beneath the floorboards. The underlay copes with uneven floors and high spots that create vulnerable areas subject to abrasion. Stanchions should not be put on the carpet and should be placed far enough away from the edgecord to prevent damage from toes on this vulnerable part of a carpet.

If visitor traffic must be directed across the carpet, a replaceable drugget of a non-abrasive covering on the pathway will protect from sharp heels, dragging feet, and tracking soils. Doorways need special attention due to the presence of thresholds and joins in the floors which are often uneven and can cause stress on carpet structure. The underlay should extend to the edge of the carpet and through doorways. Never use underlays of rubber or foam since these deteriorate and provide a separate hazard of their own to the textile material. If the path of traffic could be changed and the carpet turned periodically, wear will be more uniform. Avoid traffic patterns on the fragile fringe of any carpet. Decide if a reproduction carpet can be used, at least part of the time. Careful vacuuming is necessary on a regular basis. This is to be done daily during the busiest tourist season to minimize the abrasive action of the soil. Cleaning with vacuum should be considered part of maintenance of a collection; however it is not to be done unless necessary, i.e. preparation for storage of a piece or after open display. When using vacuum suction, there must be some way to control the amount of suction and there must be a protective barrier between the source of suction and the fragile textile. Avoid using full suction or beater bar type vacuums on any piece. The vacuum used on the textiles should <u>not</u> be used for any other purpose due to potential soil transfer and infestation.

Period rooms and historic houses have particular problems and requirements that put extra stress on the objects on exhibit. Manual intervention, such as closing of blinds and shutters at different times of the day, consistent periodic reading of monitoring equipment, recording the number of visitors and noting persistent hazards that might affect the siting or use, or conservation of an object by the room steward or docent can help to control the hazards of the environment. A roped-off area does not keep visitors from reaching over the rope to touch a hanging or sitting on a chaircord. Physical barriers such as chaircords must be constructed to give way rather than be so secure that the rope survives while stressing the wood or joins of a chair or bench. Monofilament lines can cut into wood, upholstery, and decoration and should not be used.

If damaged fabric wall coverings are reproduced and replaced, save the original as a historic accession to the collection. Much can be learned from these historic fragments. If it is necessary to reupholster a piece, get complete documentation of the historic

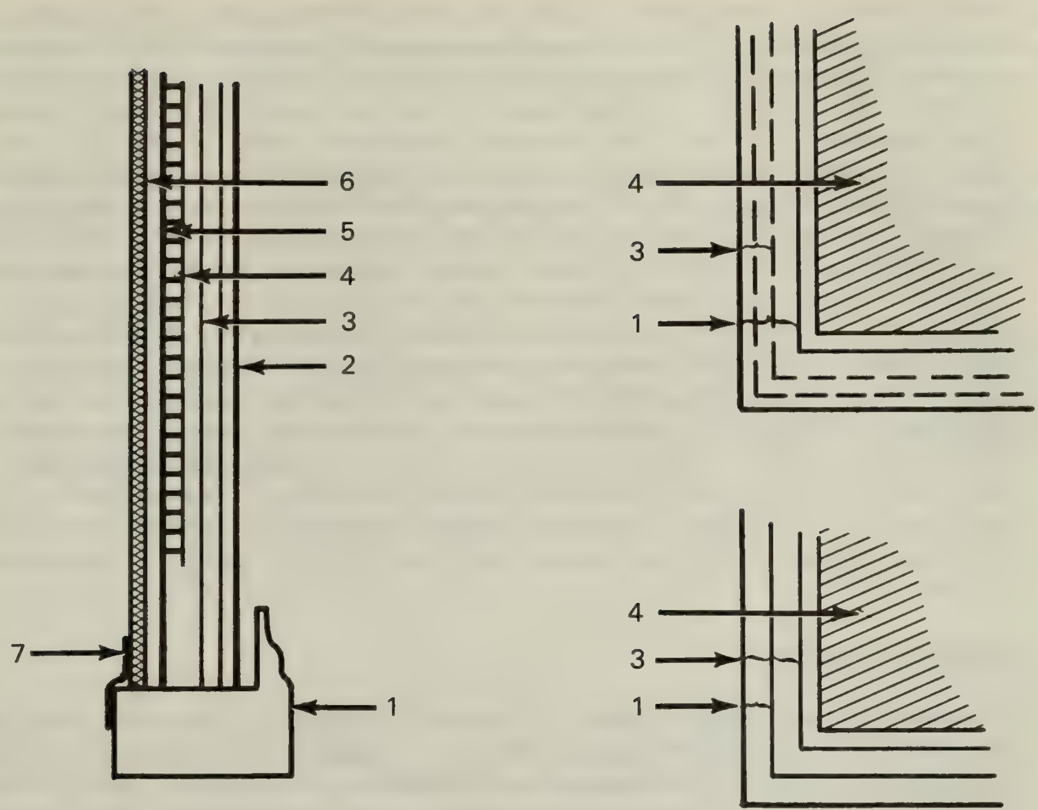
structure and consult with one of the historic furnishing experts before any disassembling or decisions on replacement are undertaken. There are many subgroups of textiles about which little is known.

During the closed season, small objects and costume should be put in safe storage. Larger pieces such as carpets, upholstered furniture, and display cases should be covered with clean cotton covers and dust sheets. Care must be taken to include enough personnel to carefully put these on and remove them from the object without causing damage to the textile. Never drag them across the piece. Be sure the closed house or site that contains objects is kept at the appropriate environmental conditions including ventilation. Remove all objects to an appropriate storage area.

2. Flat Textile Display

Flat textiles are best rested on a firm supporting background. Sewing onto a mount is not always necessary. Pins or staples should not be in direct contact with the historic textile. Use appropriate adhesives with caution and in accordance with museum specifications when securing supports and constructing cases. Points of stress should be avoided. Distribute the weight across the entire piece. This can be done by attempting to use flat or very shallow inclined supports. A flat textile can be draped over a large diameter roll or bar which is protected by an aesthetically suitable fabric barrier between the textile and the support. A draped item should not have any sharp creases or stresses causing distortion or damage to edges or corners.

Small pieces can be framed and glazed with plexiglas or UV absorbing plexiglas. Refer to Figure K.4 for illustration of constructing a frame for small flat textiles. If framed with glass, be aware of the hazard if this glass is broken. If it can be replaced with plexiglas, it will be safer on display and in storage. Remounting a piece to conservation standards may mean that original turnover is now supported flat on the mount and the mounted piece is larger than the original, as with samplers. The original frame can often be sympathetically built up to accommodate the new mount and also allow for proper airspace between the glazing and the textile. There should always be a small space between the textile and the glass (or plexiglas) to prevent direct contact and resultant damage due to pressure on fragile embroidery stitches, loss of fibers, uneven pressure, and creation of a microenvironment that would enhance microbial growth. It is important tonote that non-glare glass is not visually successful when there is an airspace between the object and the glazing.



1. Frame
2. Glass or plexiglas
3. 1/4" rabbet or mat, plain or fabric covered
4. Flat textile
5. Covered mount
6. Backboard
7. Sealing tape

Figure K.4. Frame Construction for Small Flat Textiles

Hang pieces in the warp direction if possible. Tapestries are a notable exception, due to their design and construction. Since these are hung along the weft, they are vulnerable and should be handled with care. Their weight does not equate with stability.

Mounting of large, hanging pieces should be discussed with a conservator regarding the concerns of the individual piece. A fine silk hanging will have different requirements than a heavy wool carpet or tapestry. Do not hang along the bias direction of a fabric.

Velcro is a contact fastener made up of two strips, one with a stiff pad of hooked material and the matching strip with a soft bed of

small loops. When the strips are pressed together, the hooks mesh with the loops. This is a very successful material for distributing support for flat, large, stable textiles. Never use self-adhesive velcro since there is some question as to the safety and longevity of the adhesive. If velcro is used, the hook side is sewn to the mount and the soft velcro strip is sewn to the textile. This protects the textile and allows for it to be deinstalled and stored with the support velcro intact ready for the next display. The velcro is attached to the textile with a clean cotton or linen fabric barrier between the textile and the velcro strip using a line of stab stitching across the top and middle of the velcro, leaving the bottom edge free. The hook side is attached to the mounting batten in the same manner using staggered, rustproof staples across the top and middle of the velcro strip, again, leaving the bottom edge free. When the velcro is meshed and the piece is hung, the free bottom edge will move as the textile moves from handling or unavoidable air currents. This joint movement helps to prevent separation of the velcro, or what has been described as "creep," putting the piece at risk.

3. Costume Display

The wearing of any original, historic costume is totally unacceptable within the context of museum ethics. **Costume should never be worn inside or outside the museum environment.** Accidents, perspiration, make-up, stress of dressing and wear, sudden gestures and movements all create excessive immediate hazards that cannot be justified. Again, responsible reproductions can be made and used for fund-raising events and educational purposes in conjunction with safe and stable display of the collection.

Display requires the proper representation of the fashionable profile which is appropriate to the time period. Fragile costumes need the support of a mannequin of correct size and proportion. Dummy forms can be made or purchased. On small budgets, shop discards can be acquired and modified with polyester batt and muslin to be more suitable to the display of a costume. Boy and youth figures are often more adaptable to the museum situation since they are small and can be augmented with padding to support unusual shapes and costume cuts.

The fashionable body profile changes with the period of the costume to be displayed. The mannequin should give full overall support and correct shape. A 1950s mannequin cannot not give true representation to a garment of 1890s without modification and shaping. The flat body profile of the 1960s mannequin might accommodate some of the styles of the 1920s or 1930s but the molded head and face may have to be disguised or treated so it does not distract from the garment itself. Seldom will a mannequin provide the proper support without any modification. All measurements of a mannequin should be less than the measurements of the garment. This allows for space for

proper barrier materials between the mannequin and the textile and will also provide room for padding and safe installation of the piece onto the mannequin. Padding is for support as well as to represent the history of fashion.

Undergarments have shaped and reshaped parts of the body throughout fashion history. Fabricated bustles and inner-structures may have to be made since proper undergarments for the shape of the time are rarely available and are better used for display themselves.

Garments constructed of fabrics on the bias should not be on extended display. These are prevalent in costume of the 1920s and 1930s. Dresses of this period often have few closures and can be difficult to install on a mannequin. **NO SEAMS SHOULD BE UNDONE IN ORDER TO PUT A PIECE ON DISPLAY.**

G. TEXTILE OBJECT CONSERVATION ISSUES

1. Definition

There is a clearer definition between conservation and restoration concerning textiles than with some of the other disciplines. Conservation encompasses preventive maintenance, rescue and remedial work, and research. Restoration implies a degree of repair so that a piece not only looks as it did originally but may even function as originally intended. For instance, one would conserve a piece for use in the context of a museum collection but one would restore a piece which is intended for use by a private individual (i.e., a carpet or wedding dress).

Preventive maintenance can include both active and passive measures and often involves a team approach to include the curator, conservator, educator, and designer, or the staff that represents these departments. Larger sites may have more staff involved with the decision-making process to determine the needs of the collection while smaller sites may have one or two people to cover those demands. Passive means of preservation can simply be through further documentation and cross-referencing to minimize unnecessary handling of fragile textiles during retrieval and research, or documentation of the environmental conditions of a site so that the data is available as funds may become available to actively design and implement environmental equipment and controls.

Rescue or remedial conservation is hands-on treatment of already damaged material. The majority of this damage results from mishandling and environment in and out of the museum. Sometimes a piece must be treated due to aging or failure of previous conservation and restoration efforts. Age and deterioration due to mechanical strain, environment, accidental damage, and vandalism create the need for stabilization and treatment.

Some general concerns that a textile conservator considers when choosing technique and method of conservation are:

- No treatment is undertaken that is not absolutely necessary for the preservation, safe storage, or safe display of the object

- Conservation of the textile object should involve materials and methods that are the least harmful to the original textile object

- Treatment must be as reversible as possible and should not interfere with future research about the properties of the textile and techniques used in fabrication.

The development of the field has led to a new outlook and approach to textiles. It is important to determine the treatment or method which will do just enough to make an object safe for display, study, and

storage and to appear whole. Textile conservation ethics require that everything that is original on an object be retained with nothing added that might confuse further research into the textile or social history of the piece. This also requires that previous restorations that are not actively causing damage or disfiguration of the design not be disturbed. Thorough documentation with a minimum of physical intervention is essential.

2. Cleaning

Cleaning of textiles requires a different approach from that normally used for domestic fabric. Even gentle cleaning is a drastic treatment. When an object is clean, there is no need to do anything. However, as mentioned earlier, dirt and soils are a major problem in the preservation of historic textiles. They can cause mechanical damage and deterioration, can combine with impurities and moisture in the environment and can have a chemical effect on the fibers and additives such as dyes, etc. As some soils age, they break down into even more hazardous components (e.g., drying oils by-products). These soils can also foster biological infestation.

There are four categories of cleaning: surface cleaning, wet-cleaning, dry-cleaning and spotting. Surface cleaning is mechanical cleaning, such as brushing, using dry absorbents or abrasives (e.g., erasers, drafting powder). It also includes suction cleaning by vacuum. Obviously brushing and use of dry absorbants and abrasives can be quite damaging to degraded textile fibers and should only be used by a trained conservator. These materials can cause tears and greatly affect surface luster and other optical properties. Residue of the absorbants and abrasives must be removed so they do not adulterate the textile and create an even more hazardous situation. Surface cleaning by vacuum suction should be part of general maintenance of materials on open display and before pieces are returned to storage.

Wet-cleaning or dry-cleaning should only be done by trained personnel. Any solvent cleaning is hazardous and can cause damage. This treatment is the only one that can never be completely under control. No matter how much testing for colorfastness, effect on structure, and additives, there is always the potential for an unknown. It requires extremely careful planning and the accumulation of materials and expertise that might be needed to control or cope with an unforseen reaction.

Water is a powerful solvent. Wet-cleaning implies the use of water as the basic solvent of the dirt and soil to be removed from the piece. It can also solubilize and react with dyes, degraded fibers, chemical pollutants, and a variety of other materials and additives found in and on a finished textile. Wet-cleaning requires an understanding of the physical and chemical nature of the textile, the source and chemical character of the water to be used, the properties of the correct detergent system, and the disposition of the soils to

be removed. The piece must be adequately supported since historical fibers are weaker when wet and cannot survive unnecessary handling. Composite textiles made up of many types and layers of fabric, e.g., patchwork quilts and costume, can create great problems if wet cleaned. The layers can actually trap dirt inside and accumulate soils at seam lines, colors can bleed, the different materials can react dimensionally in opposing ways to create new and damaging stresses, strains, and distortions that cannot be reversed even by a trained hand. Early decorations such as sequins were made of gelatin which is soluble in water. Even collections of what appear to be simple white baby clothes or underwear can be irreversibly damaged by washing and should never be bleached.

Dry cleaning refers to cleaning using organic solvents with or without charging agents. This method is often considered when dyes or finishes are affected by water and there is no safe method of wet cleaning. The solvents are only effective on certain kinds of oily soils and can have a drastic effect on dyes, synthetics, and decoration. They are especially harmful to humans.

Dry cleaning should never be undertaken by untrained individuals. Construction and training for use of properly modified equipment, pure clean solvents, and a well-ventilated site are very expensive and require a great deal of expertise. Few historical textiles can withstand conventional dry cleaning though some structurally sound materials can be sent out to a reputable dry cleaner who does work by hand. In general, military uniforms or recent garments may be likely candidates. The pieces must be carefully prepared by vacuuming surface dirt and soils and isolating or sometimes removing decorations and/or closures. A strong word of caution regarding synthetics: whether in the fabric or in decoration, synthetics can be drastically affected by dry-cleaning solvent. It takes a very long time for some of these dry-cleaning solvents to evaporate and they should be kept separate from the rest of the collection and in a well-ventilated area upon their return. The final decision should be made only after consultation with a conservator and the dry cleaner. **Great care must be taken to find a person who has the interest, time, and expertise to carefully handle this material.**

Spotting is the treatment of local stains with a solvent. Rarely can this be done successfully without proper spotting equipment. Often the stain is spread into the surrounding area of the piece, leaving rings of soils that are carried through the textile by absorption through the fibers. This can be especially dramatic in the case of inks. Inks from any source are very difficult to treat and can account for a great deal of paranoia on the part of textile conservators over the use of pens near a collection. If done on upholstery and fabric wall coverings, the solvent can draw out soils and colorants from the underlying materials. Spotting with solvents can also disturb the optical properties of the surface. The result often looks worse than the original stain.

All methods of conservation and treatment of individual objects involving water-based and organic solvent deacidification and neutralizing agents are to be executed only by trained conservators.

3. Techniques

Techniques used in conservation and restoration of old textiles are different from those used in traditional mending. Only the simplest stitches are used in conservation treatments and an effort is made not to overwork the piece or embroider it onto the support or mount. The techniques are similar in stitches but considerations differ from the domestic process. The role of the piece is no longer functional in the traditional sense; this is now a revered object that should no longer endure the stresses and strains of wear. The most commonly used stitches are running stitch, stab stitch, couching, herringbone and blanket stitch. Definitions and diagrams of these can be found in needlework dictionaries. The terms most frequently used are support, mount, and lining.

A support is a suitable backing that is structurally and environmentally compatible in weight, weave, type of fiber, and color (for aesthetic reasons), with the textile it is to support. It allows the fragile textile to have an overall structure enabling it to be handled as a whole with weak areas and losses protected on an overall foundation. This is to be differentiated from a temporary support that is unattached to the textile and used to transport it from one location to another. The support is usually adhered to the piece, most often with stitching, to prepare it for handling, study, or exhibition.

When a weak textile is supported, the most critical property is the compatibility of tension between the historic textile and the new support material. If stitched, and the stitches are too tight, they can cut into the fragile fibers; if too loose, there is no real support and too much movement between them is allowed, again cutting fibers and causing damage.

Support and mount are not usually the same thing. A flat mount is used for a piece that will be framed or in a closed case. A mannequin could be considered a mount for costume. The textile should be able to be removed from the mount and the piece still be protected by the support.

For open-hanging pieces, such as tapestries, there is a need for a lining. Like the mount, this is separate from any support there may be for the textile. The lining is a protective barrier and buffer between the wall and the textile and also provides dust protection. On a garment, the lining is usually part of the construction of the piece and should be considered part of the garment. Sometimes there may be an additional separate lining to protect a garment from the materials of a mannequin or armature for display.

4. Communication with the Textile Conservator

To promote communication with conservators and to help them to determine their proposal for treatment, describe everything, not just what appears to be interesting. There are many subgroups of textiles and furnishings about which little is known. Note the general observable facts and try to avoid picturesque language. The usage of terms changes with time and it is not easy to find the proper definition of a term contemporary with the piece. Costume in particular is fashionable and it is important to use the correct name for the piece rather than a fashionable name (e.g., the spencer was a short outer jacket in the early 19th century but was an undergarment in the late 19th and early 20th centuries). Try to use terms understood by all who may be dealing with the object, present and future. If you think you know the materials but are not sure or have no conclusive proof, use parentheses or put a question mark next to the identification (e.g., (wool) or wool?). Try to include only the essential measurements, overall length, width, and depth in metric dimensions.

Additional information that helps the conservator is to know the function and importance of the piece to the collection: Is it important due to historical construction or the social significance of who owned the piece? Is the original design of the piece its main concern? What is the audience for the collection?

Without disturbing the textile, describe the evidence of support method and materials presently in use. What kind of frame? What kind of materials? What obvious signs of condition are available? Is it soiled, faded, missing buttons or trim? Does it have holes and tears, obvious repairs or revision? Is the edge turned over and is it believed that any adhesives have been used? This latter point is very important since it often means extensive conservation work and potential for damage that may not be readily evident. A photograph, photocopy of a photograph and/or a diagram will help to visually illustrate information difficult to communicate in verbal terms. No true estimate can be made from the answers to these questions without actually seeing the object; however, it gives the conservator information to prepare for the visit and can save time and money during a visit, consultation, and survey.

While the piece is in the hands of a conservator for treatment, additional documentation can be done to expand research on the history and technical information of the piece. Textile analysis involves the identification of fibers and the definition of basic structure and its variations. It is very difficult with some of the more complex structures but can yield a great deal of information to the researcher, conservator, curator, and anyone dealing with or discussing the piece in the future. The careful documentation of

this information can often eliminate later unnecessary handling of the piece once it has returned to the site. This assists the conservator as often research must be done in order to make decisions about the best approach to the successful treatment of the textile.

H. PACKING AND SHIPPING TEXTILE OBJECTS

Packing provides sufficient layers of barriers to support, protect, and cushion a textile while in short- or long-term transit. You need to know the condition of the piece to determine the best way to prepare and protect it from damage. The exact measurements of the prepared piece must be known in order to fit snugly in the crate to prevent shifting during transit. The weight of the object will also affect the choice of materials to be used. Safe acid-free and non-polluting materials must be used.

Double crates are often used to help maintain environmental conditions and are usually built to include cushioning materials, which reduce shock and vibration. Cushioning is particularly important when transporting fragile composite pieces, e.g., textiles with metal threads in direct contact with fragile silk. Presently there are several groups involved with research on packing and transit.

Never transport a framed textile with glass. Fit the frame with an acrylic sheet. Wrap and interleave textiles with nonabrasive, acid-free tissue to retard surface damage and loss of fibers. Fragile objects may require special built-up supports; be sure to cover all cut edges of card and other hard materials with cushioning layers of batt, fabric, and tissue, as needed.

Use glues and sealants with caution. Be aware of metals and any protruding handles, latches, hinges, and sharp corners that may cause damage to a textile.

Very fragile pieces should not travel unnecessarily. Consider the particular piece when preparing it for travel and exhibition, especially if there are several venues. Take into consideration installation and deinstallation and the risks of handling fragile closures repeatedly. There may be alternative packing methods that could prevent excessive handling or a decision might be made to eliminate the piece from the exhibition or limit the number of venues, using substitute pieces to move with the show. **When sending a piece for conservation, consult directly with the conservator about the proper method of packing and shipping of the piece, including discussion about method of return shipment.**

I. EMERGENCY PROCEDURES FOR TEXTILE OBJECTS

In case of emergency from a natural disaster or vandalism, keep in mind that any damage is structural. Determine the extent of damage and whether it is continuing damage, i.e., hanging precariously and elongating tears. Close off the area immediately and try to assemble the amount of manpower needed depending upon the size and weight of the piece. Any unnecessary handling will create loss greater than the initial attack. Notice whether other pieces in the collection are in immediate danger and act accordingly.

The most likely problems will be physical tears, cuts, slashes, or water damage. Remember to keep all of the pieces and threads that you can and keep them with the piece. In general, try to stabilize the piece and determine the greatest hazard. If you can, document the damage with photographs while waiting for appropriate personnel. Take action to minimize the extent of the damage in cooperation with a conservator.

If the piece has been damaged by water, be aware of the additional weight of the piece. The greatest dangers to wet textiles are weakened fibers, dye bleed, and mold. The fibers will be weaker when wet, so handling is crucial. Also, if it is a large hanging or a tapestry, the weight of the water within the piece could pull it from its mount and create even further hazard to the piece and personnel.

When handling any object, be aware of any jewelry, badges, belt buckles, or watches. Try to handle with arms and hands, beware of pulling on the weak edges and corners with fingers. The most damage may come later if it is not dried properly. Dye bleed and mold are the biggest threats to these pieces. Do not dry them quickly with heat, instead set up fans for good circulation and try to absorb the moisture with dry absorbent linen, cotton, and/or clean absorbent paper.

If the action is an attack of an unknown liquid, assume the worst. The liquid could be an acid or caustic and could cause great harm to personnel. Locate protective equipment and warn everyone involved of the potential danger. With textiles, the liquid will have penetrated the fibers; do not attempt to flush with water since this will probably spread the damage throughout the piece and the heat of reaction of the water with the chemical could cause even greater damage. Contact the regional curator and the conservator according to the park's Emergency Operation Plan.

EMERGENCY GUIDELINES

- Coordinate with other emergency personnel before you prepare to detach a hanging from a wall, move costume, or furniture.
- Know your emergency plan sites for secure temporary storage and make sure your treatment areas are out of the way of other emergency crews.
- Be aware of the size of doorways, stairways, corridors, and objects that cause difficulty in maneuvering to get to the treatment destination.
- Be sure to equip yourself with protective equipment and clothing before handling any object that has been damaged by an unknown liquid.
- Attempt to move fragile damaged textiles only once, avoiding unnecessary handling.
- Carry one object at a time. Use enough manpower to safely support materials to help prevent further damage.
- Use hands and arms to support and move a piece. Never grip a corner or edge to lift or pull the object, especially when wet.
- Use a large enough cart or dolly to handle the weight and size of the object. Use protective padding, and water and chemical impermeable sheeting to temporarily prevent textile-to-textile contact as protection against further damage from dye bleed, chemical transfer, etc.
- Be careful to support the whole of the textile. Protect it from projection and mechanical damage from emergency equipment.
- Collect and preserve all fragments; save all the threads and pieces as well as samples of liquid for identification.
- No piece should be in contact with another textile or object.
- Do not flush textiles that have been subject to liquid attack. Water may enable the harmful chemical to penetrate and spread, compounding the danger. Consult with a conservator or emergency team.
- If the weight of a large hanging has pulled it from the wall and it is endangered by emergency personnel and equipment, station one person about every 2′ or 3′ along the piece. Have each person gather their section of the tapestry together and move the piece to a secure, dry location. Use paper toweling to absorb excess moisture around the tapestry. Any further treatment should be under the direction of a conservator.

J. SUMMARY CHECKLIST FOR TEXTILE CARE

Light

1. What are the light sources used in display and storage areas?

2. Are there any textiles in direct sunlight or daylight?

3. Is ultraviolet limited in any way?

4. What are the light levels on the textiles in display?

5. Is the lighting evenly distrbuted over the textile?

Relative Humidity

6. What are the RH values in the various areas of display and storage?

7. Are there areas prone to fluctuations in RH and/or temperature that can be monitored and improved by physical intervention by staff?

8. Is there a system of regular inspection for leaks and condensation related to outside walls, plumbing, or environment?

Air Quality

9. Is there an air filtration system to help reduce dust, dirt, and chemical pollution?

10. Where are the air vents and air return grates in relation to storage and display?

11. Is there a method that could be used to physically involve staff to improve the conditions?

12. Is there a regular maintenance program for good housekeeping measures to prevent the progress of infestation?

Handling

13. Has the handling and movement of the textile(s) been discussed and planned by all staff involved?

14. Is there enough staff to safely and responsibly handle the textiles in the collection?

15. Are there areas of the textile that are differentially discolored either by light or water damage?

16. Are there fragile fringes or potentially damaging attachments?

17. Is there any evidence of lost fibers in the display cases, storage tissue, or containers?

18. Are there any holes or tears that could extend if handled?

19. Is there any discoloration near attachments, indications of dye bleed, or other irregularities that might be indications of a hazardous environment (e.g., light, RH, or air quality)?

20. Are there any obvious signs of previous repairs, adhesives, or additions that are distorting and creating stress on the structure?

21. Are there worn areas, abrasions, fragile underarms, or joins (e.g., waist seams), creases, or other areas that may be stressed but not immediately obvious?

K. SUGGESTED BIBLIOGRAPHY

Textile History

Cooke, Jr., Edward S. (edited by)
1987 Upholstery in America & Europe from the Seventeenth Century to World War I. New York: W.W. Norton & Co.

Dillmont, Therese de
1987 Encyclopedia of Needlework. New York: Crescent Books,

Fiske, Patricia L. (edited by)
1976 Imported and Domestic Textiles in Eighteenth Century America. Washington, D.C.: The Textile Museum.

Montgomery, Florence M.
1984 Textiles in America, 1650 - 1870. New York: W. W. Norton Co.

Nylander, Jane C.
1983 Fabrics for Historic Buildings. 3rd ed. Washington, D. C.: The National Trust for Historic Preservation.

Ponting, K.G.
1981 Discovering Textile History and Design. Aylesbury: Shire Publications, Ltd.

Safford, Carleton L., Robert Bishop
1974 America's Quilts and Coverlets. New York: Weathervane Books.

Schorsh, Anita (edited by)
1978 The Art of the Weaver. New York: Universe Books.

1968 Textile History. Vols. 1-10. Bath: Pasold Research Present Fund/Butterworth Scientific Ltd.

Fibers

Cook, J. Gordon
1984 Handbook of Textile Fibres. 5th ed. 2 vols. Shildon: Merrow.

Hochberg, Bette
1981 Fibre Facts. Santa Cruz: Bette Hochberg.

Fabrication

Burgess, J. Tom
1977 Knots, Ties and Splices. Revised by Crab Searl. London: Routledge & Kegan Paul.

Emery, Irene
1966 The Primary Structures of Fabrics. Washington, D.C.: The Textile Museum.

Felt

Gordon, Beverly
1980 Feltmaking. New York: Watson Guptill.

Spinning

Davenport, Elsie G.
1971 Your Handspinning. Pacific Grove: Select Books.

Lace

Earnshaw, Pat
1982 A Dictionary of Lace. Aylesbury: Shire Publications, Ltd.

Earnshaw, Pat
1980 The Identification of Lace. Aylesbury: Shire Publications, Ltd.

Wardle, Patricia
1982 Victorian Lace. 2nd ed. Carlton: Ruth Bean.

Knitting and Crochet

Mariano, Linda
1977 The Encyclopedia of Knitting and Crochet Stitch Patterns. New York: Van Nostrand Reinhold.

1959 Learn How Book. 28th ed. New York: Coats & Clark Inc.

Sprang

Collingwood, Peter
1964 The Techniques of Sprang. New York: Watson-Guptill Publications.

Weaving

Burnham, Dorothy K.
1980 Warp and Weft. Toronto: ROM.

Hardingham, Martin
1978 The Fabric Catalog. New York: Simon and Schuster.

Tovey, John
1969 Weaves and Pattern Drafting. New York: Van Nostrand Reinhold Company.

Tattersall, C. E. C.
1969 Notes on Carpet-Knotting and Weaving. 2nd ed. London: Victoria and Albert Museum, HMSO.

Finishes

Gordon, Beverly
1982 The Final Steps - Traditional Methods and Contemporary applications for Finishing Cloth by Hand. Loveland: Interweave Press, Inc.

Embroidery

Enthoven, Jacqueline
1964 The Stitches of Creative Embroidery. New York: Van Nostrand Reinhold.

Hedlund, Catherine A.
1973 A Primer of New England Crewel Embroidery. 5th ed. Sturbridge: Old Sturbridge Village.

Lane, Rose Wilder
1963 Woman's Day Book of American Needlework. New York: Simon and Schuster.

Proctor, Molly
1972 Victorian Canvas Work. New York: Drake Publishers Inc.

Dyeing and Printing

1961 Painted and Printed Textiles. Los Angeles: Los Angeles County Museum.

Johnston, Meda Parker and Glen Kaufman
1981 Design on Fabrics. 2nd ed. New York: Van Nostrand Reinhold.

Montgomery, Florence M.
1970 Printed Textiles, English and American Cottons and Linens 1700 - 1850. New York: The Viking Press, Inc.

Storey, Joyce
1978 Dyes and Fabrics. London: Thames and Hudson Ltd.

Metallics

Barker, A. D.
1980 Gold Lace and Embroidery. Altrincham: Norther Society of Costume and Textiles.

Costume

Anthony, Pegaret, and Janet Arnold
1974 Costume - A General Bibliography. London: Costume Society.

Arnold, Janet
1978 A Handbook of Costume. London: Macmillan London Ltd.

Boucher, François
1987 20,000 Years of Fashion - A History of Costume and Personal Adornment. New York: Harry N. Abrams, Inc.

Byrde, Penelope
1979 The Male Image. London: B. T. Batsford Ltd.

Ewing, Elizabeth
1981 Dress and Undress. London: B. T. Batsford Ltd.

Payne, Blanche
1965 History of Costume. New York: Harper and Row.

1978 Reader's Digest Complete Guide to Sewing. Edited by Peggy Bendel et al., London: Reader's Digest Association Ltd.

Textile Conservation

Finch, Karen and Greta Putnam
1977 Caring for Textiles. New York: Watson-Guptill Publications.

Landi, Sheila
1985 The Textile Conservator's Manual. London: Butterworth & Co.

Sandwith, Hermione and Stainton, Sheila (compiled by)
1985 The National Trust Manual of Housekeeping, Chapter 14, "Textiles," 196-212. London: Penguin Books, Ltd. and the National Trust.

L. SOURCES OF INFORMATION AND SUPPLIES

1. Additional Guidance

a. Stodulski, L. P., D. Nauman, and M. Kennedy. "Technical Appendix-Analysis of Precious Metal Threads," in Fabrics in Celebration by Peggy Stoltz Gilfoy. Indianapolis: Indianapolis Museum of Art, 1983.

b. Canadian Conservation Institute (CCI-ICC) Notes 13/3, "Rolled Storage for Textiles." The Canadian Conservation Institute Notes are available from:

Canadian Conservation Institute
1030 Innes
Ottawa, Canada
KIA OC8
613/998-3721

c. Design by Janet Susan Low and Elizabeth S. Warner; copyright 1984 by the New York State Historical Association; reprinted in MacLeish, B. and Per Guldbeck. The Care of Antiques and Historical Collections, AASLH, 1985, and Canadian Conservation Institute Notes 13/5, "Hanging Storage Costumes."

d. Canadian Conservation Institute (CCI-ICC) Notes 13/5, "Hanging Storage Costumes" (cotton tape placement).

2. Sources of Supplies

a. Cotton Tapes

Testfabrics, Inc.
P.O. Box 420
200 Blackford Avenue
Middlesex, NJ 08846

Names Unlimited, Name Marker, Inc.
4450 Commerce Circle
Atlanta, GA 30336

Michael Halebian, Inc.
557 Washington Avenue
Carlstadt, NJ 07072

b. Acid-free Tubes for Rolled Textiles

Museum Services Corporation
4226 Howard Avenue
Kensington, MD 20895
301/564-1225

Archival Process Material
301 Veterans Blvd.
Rutherford, NJ 07070
800/631-0193

University Products, Inc.
P.O. Box 101
517 Main Street
Holyoke, MA 01041
800/628-1912

c. Vacuums

Vacuums are available from local vacuum sales or commercial cleaning equipment sales representatives; some are on regional or national GSA contract. Filter Queen, Rainbow, Nilfisk, Triple S*, and Clark* are all brands used in conservation facilities. They incorporate added filtration systems to reduce the amount of dust redistributed into the air exhaust mechanism. The vacuum used for the general cleanup of the workroom should not be the same as the ones used for maintenance of the textiles, if at all possible. If samples are to be analyzed, avoid the water filtration systems as water will react with and chemically change the sample material.

Note: The brands are commercial models which will require the modifications recommended in Section E of this appendix to reduce and add an element of control to the amount of suction as required by the condition of the textile object.

APPENDIX L. CURATORIAL CARE OF PAINTINGS

APPENDIX L. CURATORIAL CARE OF PAINTINGS

A. INTRODUCTION

Fortunately paintings usually hang on walls out of harm's way, for they are too fragile to survive much handling. Paintings, after all, are no more than paint films, which rest, often precariously, on supports of cloth, wood, or other materials. But in addition to being fragile, paintings are very vulnerable to environmental conditions, especially relative humidity. Old paintings that have survived in good condition probably have been subjected to little handling, and almost certainly have been kept in fairly stable environments. This appendix does not cover paintings or other works of art on paper.

B. THE NATURE OF PAINTINGS: STRUCTURE AND PROBLEMS

1. Varnish

Ordinarily, paintings have been varnished. The reasons are the same as for varnishing wood furniture -- to protect and enhance the underlying surface. Standard practice until the end of the 19th century, varnishing is still a common practice today. These varnishes usually have been made from tree resins or, more recently, synthetic resins (e.g., acrylics).

Varnishes may be soft and easily scratched or abraded. Even fingers may leave visible marks. Except when dusting, any contact with a painting's surface should be avoided.

Grime slowly accumulates on a painting's surface. When there is a varnish layer, the varnish itself, except for some of the new synthetics, discolors and darkens, gradually obscuring the paint underneath. Eventually a painting requires "cleaning." Cleaning a painting is a very delicate process that involves not only removal of grime, but usually removal of the varnish layer in whole or part. The change in a painting's appearance is often striking, as brighter colors and three-dimensional effects are revealed.

Curatorial staff who have paintings in their park collection should visit a paintings conservation laboratory to see the process of cleaning and become familiar with how important it is in the understanding and appreciation of paintings.

Curatorial staff must not try to clean a painting or make any attempt at repair. Nothing should ever be put on the surface of a painting to clean it, preserve it, or for any other reason, except by an experienced conservator.

2. The Paint and Its Support

Paint consists of pigments (fine, intensely colored powders) bound together with a "medium" formulated to give the paint desirable properties when wet, and then to dry satisfactorily. The principal ingredients of paint mediums have been drying oils (e.g., linseed oil), egg, or in recent years, synthetic resins. A wide variety of other materials has also been included.

Some pigments used in artists' paints are considered permanent. They remain stable upon long exposure to light. Artists have used many other pigments, however, that eventually fade or change color. These changes, as well as deterioration of the paint medium, can be slowed down by keeping light levels below 20 foot-candles (200 Lux) and filtering out ultraviolet radiation. In most circumstances this is enough light to see paintings well.

Paint films deteriorate for many reasons. Some are in the category of "inherent vice," such as intrinsically defective materials or incompatible combinations that defy all preservation efforts.

However, most problems arise because paintings are "composite" objects whose components respond at different rates to changes in the environment. The extremely fragile paint film (both the "design" layers on top and any "priming" or "ground" underneath) usually rests on a support of canvas or wood. These materials are hygroscopic. With any change in relative humidity (RH), their moisture contents change, and consequently, their dimensions change. They expand and contract and may twist or warp. At first, young paint films can adjust fairly well to the expansion and contraction of their supports. However most paint becomes brittle with age. Cracks appear, and finally paint flakes off. Any variation in relative humidity causes this movement, but very gradual changes may give the various parts of a painting a chance to move in unison. Rapid changes preclude this safe movement and, therefore, are more destructive.

Compounding this problem is the humidity induced action of another component of the traditional oil painting. A glue size was usually put on the bare canvas to isolate it from the paint. This layer, too, is hygroscopic, and changes dimensionally with changes in RH.

Finally, the typical painting on canvas is attached to a wooden "stretcher," a framework with corners joined to permit variable adjustment so that the canvas can be kept stretched and taut. This hygroscopic, wooden stretcher adds its own movements to the others affecting a painting.

Other physical properties of materials are affected by changes in relative humidity, and these may become important factors in deterioration, if the relative humidity reaches very high or very low levels. For example, paint films become increasingly brittle as relative humidity decreases. They lose the ability to accommodate dimensional changes, and cracking results.

Paintings conservators have numerous treatments for deteriorated paint films. Usually the priority is stabilization. Stabilization includes such procedures as facing, consolidation, lining (or relining) and removing old repairs.

A facing is a protective or "first aid" measure in which tissue is attached to the paint with a suitable adhesive. The purpose is to hold the paint in place until an appropriate treatment can be performed.

Consolidation involves reattaching loose paint to its support. Many different techniques and adhesives are used.

Lining (or relining) entails attaching a new piece of fabric or other support material to the back of the original canvas to reinforce it. Again, there are many ways to do this.

Removing old repairs is necessary in some cases when they are contributing to deterioration, as when a patch distorts surrounding paint.

Restoration is often necessary, in addition to stabilization. The purpose of this phase of treatment is to make a painting more accurately understood or appreciated by removing misleading repairs, or by making damages less conspicuous. Cleaning, as described above, is often an important part of the restoration process.

Paint added during an earlier restoration may no longer match, or may be excessive, according to current conservation standards. Usually it is feasible to remove this added paint. Discuss this procedure with your conservator. Ensure that the total extent of previous restoration is delineated and documented.

Missing areas can be made less distracting. In the past it was common practice to conceal losses by extensive repainting, going beyond what was actually missing. Today this "overpainting" is avoided. Conservators carefully "inpaint" so that original paint is not covered.

Discuss any proposed inpainting with the conservator. For one thing, inpainting takes time and can be an expensive process. Perhaps the painting really only needs stabilization. On the other hand, carefully applied inpainting may be essential in making a painting exhibitable. In most cases damages should be concealed sufficiently so that they do not distract from the whole. Seeing and appreciating the extant original of a painting is the point of doing any restoration at all.

It is also important that the conservator use a paint for "inpainting" that does not discolor and can be removed readily in the future, with no harm to the original paint. There is no reason to attempt to duplicate the original paint medium, such as using oil paint to inpaint an oil painting. Good results can be obtained with paints that are safely reversible.

C. PREVENTIVE CONSERVATION OF PAINTINGS

1. Environment

a. Relative Humidity (RH)

Maintain a stable level; avoid extremes. Aim to keep the RH level within 5%, plus or minus, of the set point. If the set point must be changed, do it gradually, over weeks or months, so that the various hygroscopic materials in paintings can adjust in unison.

Maximum safe RH is 65%. Higher levels promote mold growth. Circulate the air to disperse stagnant pockets of dampness. Watch out for cool walls (usually external) where RH in the space behind a painting can be higher than room level.

Minimum safe RH is 40%. Below this point is the danger zone, except in arid climates where paintings may have adjusted to lower levels. In winter, heated buildings climatically resemble desert environments, with RH at 20% or below. To raise RH levels, turn down the heat! A reading of 30% RH at 80°F, will be increased to better than 40% RH at 70°F, and to a very healthy 50% RH at 65°F. Remember that there is soot or dust above a fireplace or radiator and also a warm wall which creates a "microclimate" dryer than the rest of the room, perhaps dangerously so. Hot lights, even picture lights, do the same.

b. Temperature

For paintings, temperature is less important than relative humidity. Maintain a temperature level below 80°F and above freezing. Within this range, the lower the temperature the better. However, a painting may be harmed by condensation if it is moved quickly from a cool area to a warm area. Temperature changes always should be gradual.

c. Light

A light level of 20 foot candles (200 Lux) is enough for almost all circumstances. Ultraviolet (UV) radiation should be filtered out of light sources, such as daylight or fluorescent lights, that contain more UV than the normal incandescent lamp (75 mW/lumen).

2. Framing/Hanging

a. Is the painting secure in its frame? Check on this, especially when a painting is to be moved. A good method is to use bendable metal straps (e.g., brass mending plates) and screws to secure a painting in its frame.

b. Is the frame hardware adequate and secure? Screw eyes tend to work loose over the years and should be checked periodically.

Mirror hangers" work well. For larger paintings, use two on each side, with one or two picture wires apiece.

c. Is the supporting wire strong enough and securely attached? Number 8 wire (about 1/8" or 2.5 mm in diameter) should be considered minimum, and heavier paintings need two or more wires. Replace frayed, partially broken wire. Inspect picture wires periodically as part of the museum housekeeping program.

d. Instructions for attaching picture wire to a hanger are outlined and illustrated in Figure L.1.

e. Does the wall (or storage screen) provide secure attachment? A wide variety of hooks, nails, screw eyes, anchor bolts, toggle bolts, molly bolts, etc. may be used, depending on the type of wall and the weight involved. What matters is that the wall/hardware combination can support the weight indefinitely. Periodically check this.

f. Does the painting have a protective backing of cardboard (or Fome-Cor®)? This is especially important when a painting is off the wall for any reason.

3. Storage

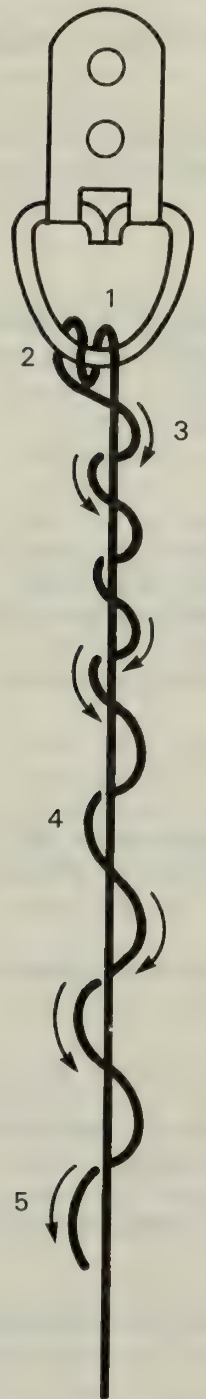
a. Let nothing rest against a painting's surface which might poke, tear, deform, or adhere to it. This applies as well to the back of a painting on canvas.

b. See NPS Conserve O Gram 12/3: "Painting Racks" for information on building "screens" for storing paintings safely, off the floor, yet easily accessible. Similar screens are available commercially.

c. Separate paintings with cardboard if they lean together in a bin or a stack against the wall. Do not permanently stack paintings against a wall exposed to the outside of a structure.

d. Cushion and protect frames, using materials such as polyethylene foam or strips of carpet, whenever frames are off the wall. Padded blocks are useful when working with frame paintings. Simple ones can be made from pieces of wood (e.g., "2x4's") by cutting foam or cotton batting to fit a side and stretching fabric over it. Refer to Canadian Conservation Institute Notes 10/2, "Making Padded Blocks" for techniques for making padded blocks.

The instructions for attaching picture wire to a frame's hanger are outlined in the below figure. Each step is keyed to the illustration by the indicated number.



1. Attach picture wire to hanger (or screw eye) by inserting the end of the wire through the loop in the hanger.

2. Wrap the wire around the loop and through the loop again, pulling the wire snug against the loop.

3. Tightly wind the end 4 to 5 times around the wire next to the hanger.

4. Wind wire loosely around itself several additional times.

5. Cut off the surplus wire.

Repeat this procedure for the hanger on the other side of the frame. Ensure that there are no loose loops or spaces in the finished knot.

Figure L.1. Steps for Attaching Picture Wire to a Frame's Hanger

e. Use cushions or boards to keep paintings off the floor. This makes housekeeping easier and helps keep paintings out of the dust and debris that tends to accumulate on floors, as well as any water leaking from pipes or humidifiers. Refer to Canadian Conservation Institute Notes 10/2, "Making Padded Blocks." This publication is listed in Section D of this Appendix.

f. Cover paintings stacked against a wall with polyethylene, paper, or other sheeting to keep dust off.

g. Avoid possible water leaks, e.g., from overhead pipes. Drape plastic sheeting over stored paintings if there is any chance of water dripping from above.

4. <u>Touching and Vandalism</u>

Paintings on exhibit are tempting targets for touching and vandalism. There are many ways to prevent or reduce the possibility of these hazards.

a. Park staff may be stationed in the immediate vicinity of paintings.

b. Framed paintings usually may be fitted with glass or acrylic sheet (e.g., Plexiglas) inserted in the rabbet of the frame and separated from the painting itself by a "spacer" at the edges.

c. An acrylic sheet case may be fitted around the painting and attached directly to the wall.

d. Paintings may be put in exhibit cases.

e. Paintings may be placed out of reach by using guard rails, stanchions and ropes, platforms, furniture, or other physical barriers.

f. Appropriate alarm systems may be installed to detect when a painting is touched or lifted or both.

5. <u>Handling</u>

In addition to general rules for object handling discussed in the Chapter 6 of this handbook, observe the following rules:

a. Never touch the paint surface or push on the canvas from the reverse.

b. Make sure a painting is secure in its frame before moving or carrying it.

c. Carry no more than one painting at a time. Get help in carrying a larger or heavier painting.

d. Do not lift paintings by the top of the frame or stretcher. Carry with one hand on each side; or one on one side, and one on the bottom.

6. Monitoring and Documenting Condition

Since paintings are interacting constantly with the environment and intermittently with people, it is important to monitor them for signs of wear and tear, vandalism, or other changes. Each painting should have ngoing condition record, with dated entries. Good photographs are very desirable, for conditions may be too complex or subtle to describe in words. Graph paper makes a convenient form for recording the location of cracks, tears, holes, abrasions, scratches, rubs, etc.

a. Watch for Signs of Loose Paint

Use good light, both from normal lighting angles and especially from the side, at a "raking" angle over the surface. Look for the raised corners or edges of paint along cracks. Paint usually detaches itself gradually and can be saved if a conservator is consulted in time. Cracking may not mean paint loss is imminent, but close monitoring is advised, with periodic examinations by a paintings conservator. Some "cracks" are not threatening (although they may well be disfiguring): sometimes paint moves or shrinks during drying, and separations appear without any paint actually being loose or likely to flake off. These are "drying" or "traction" cracks.

b. Wear and tear is difficult to monitor since it occurs in small increments, insidiously altering museum objects. Yet small scratches, rubs, chips, stains, fingermarks, and other blemishes are real damages, often irremediable. Examine paintings closely for signs of wear and tear, and watch out for any circumstances in which it may be occurring, whether in storage or in exhibit areas.

c. Vandalism should be detected immediately, so that corrective treatment may be prompt, but also to forestall further incidents.

d. When damage such as a scratch, tear, or dent is discovered, look closely to assess the situation. However, do not touch the surface of the painting. In these circumstances the slightest touch can dislodge paint. Similarly, do not try to remove foreign material from a painting's surface. Contact a paintings conservator as soon as possible.

Paintings should be examined periodically. Take a daily walk through the exhibit and storage areas and look for any obvious problems, such as vandalism. A closer inspection of each painting for loose paint or any new signs of damage or deterioration should take place on a monthly basis. A good flashlight is very helpful. Use raking and reflected light. Refer to Canadian Conservation Institutes Notes 10/7, "Condition Reporting - Paintings," listed in Section D of this

appendix, for the methods of examining a painting for its condition. Record your observations and any actions taken. Have a paintings conservator conduct a Collections Condition Survey of all paintings in the park's collection. The staff persons who ordinarily do the daily "walk-throughs" and monthly inspections should work with the paintings conservator during the site visit.

7. Dusting

Dusting is seldom necessary in clean environments, since paintings are usually in a vertical position. If dust is noticeable, proceed with extreme care, as paint can be dislodged or the surface scratched. Preferably have a paintings conservator do the dusting or provide instruction on how to do it. In any case, use good light and make sure that no paint is loose. Use only a very soft, clean brush. Some animal hair artist's brushes (e.g., sable) are suitable. A convenient size is 2-3" wide. A good source for this brush is an artist supply store. Start at the top, brushing downward gently and checking closely, from different angles, to ensure that the surface is not being scratched or marred.

D. EMERGENCY PROCEDURES FOR PAINTINGS

Refer to Chapter 8, Section F for procedures for emergency treatment and handling of museum objects. Specific guidelines for handling paintings in an emergency are as follows:

1. Do not attempt to remove mud.

2. Drying may involve serious paint loss - watch for loose flakes.

3. If paint is loose, store painting horizontally (face-up), supporting canvas from behind, if it appears weak. Otherwise, store vertically.

4. Keep each painting separated from others.

E. SELECTED BIBLIOGRAPHY

Canadian Conservation Institute
1986 "Making Padded Blocks," CCI/ICC Notes 10/2. Ottawa, Canada: Canadian Conservation Institute.

The Canadian Conservation Institute Notes are available from:

Canadian Conservation Institute
1030 Innes
Ottawa, Canada
KIA OC8
613/998-3721

Canadian Conservation Institute
1987 "Condition Reporting - Paintings," CCI/ICC Notes 10/7. Ottawa, Canada: Canadian Conservation Institute.

Keck, Caroline K.
1965 A Handbook on the Care of Paintings, New York: Watson-Watson-Guptill Publications for the American Association for State and Local History.

Sandwith, Hermione and Sheila Stainton (compiled by).
1984 The National Trust Manual of Housekeeping, Chapter 11, "Pictures," 140-173. London: Penguin Books, Ltd. and the National Trust.

Stout, George L.
1975 The Care of Pictures, New York: Dover Publications, Inc.

West, Pamela
"Painting Racks," NPS Conserve O Gram 12/3. Washington, D. C.: National Park Service.

APPENDIX M. CURATORIAL CARE OF CELLULOSE NITRATE NEGATIVES

APPENDIX M. CURATORIAL CARE OF CELLULOSE NITRATE NEGATIVES

A. INTRODUCTION

The first successful form of flexible photographic film was introduced by George Eastman in 1889. The new negative film was comprised of a gelatin emulsion adhered to a thin support of clear cellulose nitrate. Prior to this time, the supports for photographic negatives had been made of a number of different materials, including paper, glass and gelatin. The new flexible film had several great advantages over the earlier negative supports. It was especially the ease of handling, lightness and flexibility of the new negative stock that inspired radical changes in the design and technology of cameras. With these changes and the advent of cellulose nitrate film, photography became accessible to anyone who could hold a box camera. This film, for all of its great advantages over previous negative forms, had one great disadvantage: it is a highly flammable and unstable material.

Although cellulose nitrate film was produced from 1889 to 1951, it was used primarily during the period 1900 through 1939. Cellulose nitrate film gradually replaced dry plate (glass) negatives until, by the mid-1920's, virtually all photographers, both amateur and professional, used the flexible film exclusively. By 1935 film manufacturers had begun to market "safety film" to replace the flammable and unsafe cellulose nitrate film. After 1939 the majority of still photography was produced on a form of "safety film." Some cellulose nitrate film was produced after this date, and 35mm motion picture film continued to be made of cellulose nitrate until 1951.

Preservation of cellulose nitrate negatives consists of several phases: isolation and short-term storage, high quality duplication of the negatives, and retention and long-term storage of the original negatives. This appendix provides guidance on the curatorial care and safe handling of cellulose nitrate still photographic film. Where appropriate, guidance is also provided on the care and handling of cellulose nitrate motion picture film.

B. THE NATURE OF CELLULOSE NITRATE FILM

Cellulose nitrate film is a highly flammable and potentially dangerous material. The flash point of cellulose nitrate film in undeteriorated condition is approximately 300°F (173°C). The film is, however, inherently unstable and the flash point can fall as low as 120°F (70°C). This presents a serious safety problem for any collection with a quantity of cellulose nitrate material. There is a history of fires that have been caused by improper storage of cellulose nitrate film, especially motion picture film. Because this material contains its own supply of oxygen, it creates an intense fire. Carbon monoxide, nitrogen peroxide, and other gases released by a cellulose nitrate fire pose a serious threat to life. Nitrogen peroxide is particularly lethal because of its corrosive action on human tissues.

The film also is a danger to all materials stored with it. Materials in direct contact with or stored in the vicinity of deteriorating cellulose nitrate film will become contaminated and damaged by the nitrous and nitric acid that are by products of the deterioration.

Cellulose nitrate motion picture film is considerably more volatile than still photographic film, because there is a greater density of material within the same given space. Once deterioration starts in motion picture film, it spreads much more rapidly. Likewise, the mass of motion picture film makes it more likely to spontaneously combust and to start a major fire.

If not stored under refrigeration, the film, during the last stages of deterioration, is very susceptible to accidental combustion. Since it is inherently unstable, cellulose nitrate film decomposes even under the best of storage conditions. Although much cellulose nitrate film has lasted nearly 100 years and has survived in fairly good condition, this material is volatile enough that it can deteriorate rapidly and unpredictably. Proper storage conditions can reduce the risk. The following five stages of deterioration have been identified:

1. The film base discolors from crystal clear to amber with some fading of the image. The discoloration may appear only on parts of the negative.

2. The emulsion becomes soft and tacky, often adhering to other film or paper. The film base may become brittle. The odor of nitric acid may be perceptible.

3. The film is extremely brittle. Gas bubbles may be contained between film and emulsion. The film emits a noxious odor of nitric acid.

4. The entire film softens and is welded to adjacent film or other materials. The sticky mass of film emits a strong odor.

5. The film mass disintegrates partially or entirely into a brownish, acrid powder.

The above signs of decomposition may differ depending on the climate, environment, the manner in which the film was manufactured, and other factors. These stages of decomposition should be used as a general guide.

In spite of the nature of this material, it is possible to store and use stable cellulose nitrate still film in a way that minimizes the risk to staff and other collections.

C. IDENTIFICATION AND ISOLATION OF CELLULOSE NITRATE NEGATIVES

The first step in the management of a photographic collection containing cellulose nitrate negatives is to **identify and isolate** the negatives. Park staff must be made aware of possible health effects from working with deteriorating nitrate negatives. Refer to Section D of this Appendix for steps to follow in minimizing health risks.

1. Identification of Cellulose Nitrate Negatives

Examination of each suspect negative and its documentation should always be the primary means of identifying nitrate negatives. Two tests, as noted below, can be used to determine whether a negative is nitrate or safety film. However, these tests should only be used, when examination of the negative is inconclusive.

a. Date of Manufacture

By the mid-1920's some still photographic film was manufactured using a new film base, a so-called "safety" base. This new type of flexible film consisted of a base of cellulose diacetate. However, this new "safety film" was not widely marketed and used until the mid 1930's. Some cellulose nitrate flexible film continued to be manufactured until 1951. The majority of film dated before 1939 found in museum collections will be cellulose nitrate. The majority of film dated after 1939 will be safety film. However, stockpiles of cellulose nitrate film continued to be used for several more years. Refer to Figure M.1 for the last dates of manufacture of the primary formats of cellulose nitrate film. These dates have been supplied by Eastman Kodak Company for films made by them. No dates are available for other manufacturers.

Types of Film	Year of Last Nitrate Film Manufactured by Kodak in US
X-ray films	1933
Roll films in size 135	1938
Portrait and commercial sheet films	1939
Aerial films	1942
Film packs	1949
Roll films in sizes 616, 620, etc.	1950
Professional 35mm motion picture film	1951

Figure M.1. Types of Kodak Nitrate Film and Last Year of Manufacture

b. Internal Evidence

Examine the negative carefully to determine whether it is cellulose nitrate.

- Attempt to determine the approximate date of the negative from the photographer's notes, other associated data, or the subject matter of the negative.

- Most nitrate sheet film (usually 4x5, 5x7, or 8x10 formats) was identified as such on the edge of the film (e.g., Eastman Nitrate Film). Once safety film was introduced, it was similarly identified (e.g., Ansco Safety Film).

- However, some sheet film may not be identified as either safety or nitrate film. The edge imprint may only indicate the manufacturer (e.g., Eastman Film). Until proven otherwise through testing, assume that this last type of film is nitrate.

- Other small format types of cellulose nitrate film, such as roll film or film packs, were not identified by an edge imprint. Often cellulose nitrate film can be identified by the smoky, transparent gray color of the film base. This clue should be used in association with other evidence.

- Other points of identification include the characteristic yellow-brown color of deteriorated nitrate negatives and the characteristic heavy odor of nitric acid.

c. Testing for Cellulose Nitrate

1) **Flame Test.** Cellulose nitrate film burns quite differently from safety film. Snip off a small strip of a negative known to be nitrate. Also snip a small strip of a safety film negative. Outdoors or under a fume hood, light each piece, observing the different burning characteristics of each. Nitrate base film will ignite and burn rapidly. Safety film will not ignite easily, nor will it continue to burn. Rather it will melt. This is not an absolutely infallible test, but it is generally quite reliable. Because of its simplicity, this is the preferred test. **Use caution because cellulose nitrate film is highly flammable.** Use only a small piece of film. One inch by one-fourth inch is suitable for this test. **Hold piece of film with a pair of tweezers.**

2) **Trichloroethylene Test.** Snip a bit of the edge of a suspect piece of film and place it in a small bottle of trichloroethylene. Shake the bottle, making sure the piece is fully immersed. If it sinks, it is cellulose nitrate film. If it floats at the top it is cellulose diacetate or cellulose triacetate film (forms of safety film). If the piece floats in the middle of the bottle it is polyester film which is another form of safety film.

   Caution: Trichlorethylene is a known carcinogen. This material should be used with extreme caution and care. Use this material only in a well-ventilated space. Wear latex gloves. At times this test can produce confusing results.

Use either the flame test or the trichloroethylene test **only after attempting to determine the date of the image and after inspecting the negative visually.** If no clues are evident after this inspection, then resort to one of the two tests. For assistance contact the Regional Curator. In the greatest majority of cases, cellulose nitrate motion picture film is identified by the absence of the words "safety film" on the film.

2. Isolation

   a. Survey collections for nitrate negatives as they are received. Survey photographic materials already in the museum collection for nitrate materials.

   b. Once they have been identified, store all nitrate negatives and motion picture film safely and separately from all other materials in the museum collection. Jacket each negative separately in a buffered, acid-free envelope. Transcribe relevant information from the original envelope, photocopy original envelope, and then dispose of original envelopes. Clearly mark each new envelope as containing cellulose nitrate film. In an uncataloged collection, note information relevant to the original location of nitrate negatives.

   c. Separate negatives showing signs of deterioration from all materials, including other cellulose nitrate negatives. These deteriorated negatives should be duplicated as soon as possible. These negatives must be discarded after the images have been duplicated. Refer to Section J of this Appendix for disposal procedures.

3. Short-term Storage

   The final step in isolation of cellulose nitrate negatives is storing the negatives in a stabilized environment until the negatives have been duplicated and until a long-term storage solution has been implemented. A short-term storage solution must allow for storage of nitrate negatives for one to five years. There are several options for short-term storage.

   a. Storage Equipment

      - The preferred method is to store the negatives in a dedicated freezer. Freezing the negatives will do them no harm if they are properly handled. Freezing will, however, slow down the deterioration to a much greater degree than any other method of storage. A dedicated freezer is also a long-term storage solution.

      - Negatives also can be stored successfully in a dedicated frost-free refrigerator. For short-term storage, this is somewhat less desirable than freezing since deterioration will

not be slowed as greatly. The refrigerator should be set at the lowest possible temperature.

- Negatives can be stored in any available refrigerator, dedicated or not, until a dedicated freezer or refrigerator becomes available. Because access to these volatile materials must be limited and because contamination of the negatives by other materials in the refrigerator is possible, <u>this is recommended only as an interim, very short-term solution</u>.

- When storing negatives in a refrigerator, utilize the wire racks or other devices to ensure good air circulation within the refrigerator. Keep negatives off the bottom of the refrigerator, utilizing a rack or other device to prevent water, which can collect at the bottom of the refrigerator, from damaging negatives.

- If no refrigeration of any sort is available, the negatives should be stored in a secure, cool, dry place, away from the museum collections and as far as possible from flammable liquids and materials. <u>Again, this is recommended only as an interim, very short-term solution</u>.

b. Packing Nitrate Negatives for Storage

The method by which negatives are packed for storage should be based on the following factors:

- Is the storage dedicated?
- Are the negatives to be stored in a freezer or refrigerator?
- Will access to the negatives be necessary for reasons other than duplication (e.g., research, exhibits)?
- Are the negatives deteriorated?

The three recommended methods for packing nitrate negatives are as follows.

1) Heat-sealed metal foil/plastic laminated pouches. Refer to the NPS <u>Tools of the Trade</u> for sources of this type of pouch. Each pouch should be marked noting its contents and the fact that nitrate materials are enclosed. In preparing each pouch for storage, eliminate as much air from the pouch as possible by pressing it out. This method should be used when film is to be frozen. Motion picture film stored in a freezer should be left in its canister inside a pouch. Pouches also should be used for the additional isolation necessary for deteriorated negatives or motion picture film, whether they are stored in a freezer or refrigerator. In this way, off-gasing can be contained and prevented from deteriorating other negatives. It also can be used for undeteriorated negatives stored in a refrigerator. This method should <u>never</u> be used for storing

negatives that are not stored in a freezer or refrigerator. <u>This is the preferred method for packing negatives that are to be stored in a freezer</u>.

2) Resealable bags. These should be the heavy duty freezer type available from the General Services Administration and local sources. Generally, these bags should be used for all undeteriorated negatives and motion picture film under refrigeration. Bags of 15 to 50 negatives can be arranged inside acid-free boxes to improve their organization within the refrigerator. All air should be removed from each bag as it is packed. This method should <u>not</u> be used for packing negatives that are not to be stored under refrigeration.

3) Acid-free boxes. These can be used in conjunction with either zip-lock bags or heat-sealed pouches for better organization of the materials. They can also be used for undeteriorated negatives in a refrigerator, without zip-lock bags. Because the zip-lock bag affords an extra degree of protection from condensation upon inserting or removing negatives in a refrigerator and from water damage from a malfunctioning refrigerator, storage in boxes without bags is not recommended. <u>This is the preferred method for packing negatives or motion picture film that will not be stored in a refrigerator or freezer</u>.

c. Monitoring

Cellulose nitrate negatives and the equipment in which they are housed must be monitored constantly. Ideally, all equipment should have a temperature alarm which will signal when a certain temperature has been reached, indicating a problem with the equipment. All equipment should be monitored several times a week. Each piece of equipment should be equipped with either a recording thermometer, recording hygrothermograph or a thermometer and dial hygrometer. In the case of non-recording instruments, a chart for recording readings should be attached to the equipment.

The negatives themselves must be monitored, depending on their condition and the storage equipment. All undeteriorated negatives stored in a freezer should be examined at least <u>bienually</u>. All undeteriorated negatives stored in a refrigerator should be examined at <u>least once a year</u>. Deteriorated negatives should be examined at least <u>once every three months</u>.

d. Removal of negatives from refrigeration.

Each laminated pouch of negatives removed from a freezer will require at least two days to acclimate to room temperature. The pouch should not be opened until it does come to room temperature.

Negatives removed from refrigeration will require four to eight hours before the bags can be opened. Boxed negatives stored under refrigeration without bags must be bagged as they are removed from the refrigerator and then allowed to come up to room temperature.

D. STEPS TO MINIMIZE HEALTH RISKS

The volatile, flammable characteristics of deteriorating cellulose nitrate film have long been known. In addition, cellulose nitrate film outgasses by-products that cause deterioration of other photographic materials stored in the same space. Nitrate film emits a distinctive, heavy, noxious odor. Recently museum staffs working with deteriorating cellulose nitrate have experienced adverse health effects. Acute symptoms have included eye irritation, rashes and sores on the face and skin, vertigo, nausea, headaches, swollen glands and respiratory irritation and difficulty.

Deteriorating cellulose nitrate negatives emit harmful gases. These gases are considered deep lung irritants. Repeated exposure by inhalation in low concentrations may result in chronic symptoms. Long-term exposure may result in bronchial irritation and the development of an emphysema-like condition. The silver salts present in negative emulsions also may irritate the skin.

Park staff need to follow several steps to minimize health risks:

1. Plan for the project. Consider work-space needs, estimate time, and identify any special protective equipment.

2. Establish proper ventilation in the work space to ensure that concentrations of any emitted gasses are removed from the employee's breathing zone. Refer to Chapter 11 for a discussion of ventilation and respirators.

3. Goggles should not have to be worn if proper ventilation is established. Avoid wearing contact lenses when working with negatives for any length of time. Gases may concentrate under contact lenses causing eye injury and damage to the contact lenses.

4. Wear vinyl or latex gloves when handling negatives to minimize risk of skin irritation.

5. Limit the handling and working time to two to three hours per day.

6. After each working session, clean work surfaces with a solution of baking soda and water. Mix a teaspoon of baking soda to each pint of water. This solution will neutralize the acids that may be deposited by the negatives.

7. Keep a log in the work area to note any odors detected, the time spent each day on the project, and any physical discomforts experienced. If any ill effects are experienced, notify the supervisor.

Remember, these health risks are generally a matter of concern only when working with nitrate negatives evidencing signs of deterioration.
Refer to Chapter 11 and Appendix H for guidance on health and safety in the curatorial workplace.

E. DUPLICATION OF NITRATE NEGATIVES

1. Standard

Photographic images record "visual information" consisting of the objects represented in the image conveyed through the photographic medium in a manner unique to the photographic medium. The unique "quality" of the information (i.e., the manner in which the information is recorded and conveyed) differs from one photographic medium to another. The differences between modern and historic photographic media include differences in density ranges, in how various colors are "read", the degree of detail that can be conveyed in highlights and shadows, etc. In order to accurately preserve the historic photographic image, it is essential that duplicate negatives represent as completely as possible all of the information conveyed by the original negative, including the recorded objects and the quality of that information. Therefore, high quality modern duplicate negatives must be the standard for preserving historic negatives (and all historic photographic materials in general).

2. Methods

The most practical method of preserving the image (intellectual content) of cellulose nitrate negatives is high quality duplication on safety film. There are several methods of duplication that will produce satisfactory results and preserve the historic image. The image should be preserved as exactly as possible. Strict quality control must be exercised in order to retain the original quality, tonality and relative density. There are at least three methods for duplication of cellulose nitrate negatives.

a. Contact Interpositive method: **This is the preferred method of duplication.** A film interpositive is made from the original negative by exposing a piece of film in direct contact with the nitrate negative. The two pieces of film are laid emulsion to emulsion and exposed in a contact printer. A contact duplicate negative is made from the interpositive in the same way. The contact exposure ensures the sharpest image. The production of both an interpositive and a duplicate negative enhances the preservation of the images. This method meets the standard for accurately recording information. In addition, because both an interpositive and duplicate negative are created, preservation of the images is greatly enhanced.

b. Direct duplicating film: This one step method of duplication ensures excellent quality duplicate negatives, especially if the film is exposed in a contact printer. Direct duplicating film for this purpose (Kodak 4168) has been somewhat controversial, however, since the film has reportedly proven to be unstable in certain applications. The manufacturer has recommended treatment of the processed duplicate negatives with selenium toner to prevent any potential fading problems.

c. Copy negative: By this method, a large format copy negative (4x5 or larger) is made of a high-quality print from the original nitrate negative. Of these three this is the least precise method of duplications because of the necessity for printing and copying through the lenses of the enlarger and copy camera. In general, this is the least acceptable method.

3. Specifications for Duplication

All duplication should be according to the highest professional standards.

a. The film should be a fine grain film normally used for the production of half-tone negatives (e.g., Kodak Commercial Film). Exposure and development times should be based on density readings for each negative as determined by a standard photographic densitometer. Exposures should be made in a professional quality contact printer. This should ensure a complete contact between the emulsions of the two pieces of film. Often, when negatives have begun to show signs of deterioration, they will buckle, making it difficult to get a good contact. If good contact cannot be made, it may be necessary expose the modern film by projecting the original through an enlarger. Exposures should be made in a professional quality contact printer. These basic specifications will ensure the highest quality preservation of the original images.

b. All processing should be to American National Standards Institute (ANSI) standards for archival processing. Refer to Section J of this appendix for the source of these standards. The only accurate test for ANSI archival processing is the methylene blue test. This test is commonly used by commercial microfilm producers, although rarely used by other commercial photographic firms. Contact the Regional Curator for sources to conduct this test.

c. A few NPS photo labs have considerable experience with producing quality duplicates of cellulose nitrate negatives. Check with the Regional Curator for a lab that may be close to the park. If one is not available, there may be a commercial photo lab nearby that can produce high quality archival duplicate negatives.

d. If a decision is made to use a commercial lab, the park staff should ensure that the lab is capable of producing high quality duplicates processed according to ANSI archival processing standards. Before finalizing a contract for nitrate duplication, have the commercial lab process a test batch. Require the lab to have a microfilm lab perform the methylene blue test on a test strip from the batch. **During the project, frequent monitoring of the duplicate negatives for quality is essential.**

e. Duplication of movie film should be processed by a professional motion picture laboratory on a fine-grain film with correction for lighting. The process should yield the highest quality duplicate.

F. PACKING AND SHIPPING NITRATE NEGATIVES

It may be necessary to ship negatives to the nearest National Park Service lab or to a commercial lab. Since these historic negatives are flammable, unique and fragile, they should be packed and shipped carefully. Pack and ship cellulose nitrate negatives in small batches of 100-200.

a. Jacket each negative individually.

b. Pack 25-50 negatives in small boxes. These boxes should be of a size that restricts the movement of the negatives.

c. Place each box in sealed plastic bags.

d. Pack the individual boxes in a larger box with sufficient strength to withstand the shock of anticipated handling.

e. Enclose a complete inventory of all negatives in the box. Send a copy of this inventory under separate cover to the laboratory. Retain one copy for park files. The inventory should include the negative number and a brief description of the image (e.g., size, dates).

f. Consult the Regional Curator about the appropriate shipping method.

G. DISPOSITION OF INTERPOSITIVES AND DUPLICATE NEGATIVES

After duplicating the nitrate negatives, catalog and store the safety film duplicate negatives and interpositives. Each individual piece of film, (e.g., nitrate negative, safety duplicate negative and safety interpositive) should be individually jacketed in an appropriate negative envelope. Use a <u>non-buffered</u> acid-free envelope for safety interpositive and safety duplicate negatives. Use a <u>buffered</u> acid-free envelope for nitrate negatives. Using a pencil or typewriter with carbon ribbon, label the envelope before inserting the negative. Include in the label all the pertinent information from the original envelope (e.g., the subject of the image, date, photographer and the original negative number). The envelope should be annotated with the current negative number and/or museum catalog number and the form of the image enclosed (e.g., "safety film negative"). Refer to the NPS <u>Tools of the Trade</u> for sources of envelopes.

The catalog records for the original nitrate negatives should be annotated to indicate the existence of the duplicate negative and interpositive. If possible, store the interpositives and duplicate negatives separately. The interpositives should be treated as if they were original forms of the images. They should not be handled except to make additional duplicate negatives.

H. RETAINING ORIGINAL NITRATE STILL NEGATIVES AFTER DUPLICATION

After a quality duplicate image has been produced, any nitrate negatives showing evidence of deterioration should not be retained. Duplicate images on nitrate film should not be retained. However, discard duplicates with caution. Images that appear duplicate may contain vital details of documentary significance. Nitrate negatives that are, themselves, copies of extant images need not be retained. Negatives that have no significance to a park's history or museum collection need not be retained. Once movie film has been duplicated, the original should be stored in a reputable repository of historic motion picture footage. Consult the Regional Curator for locating an appropriate repository. If no repository is available, the film should be destroyed.

The criteria for retaining nitrate still negatives are as follows:

1. Duplicating Quality of Original Nitrate Negatives. Original negatives will produce the finest quality prints for exhibit and publication purposes. No matter how careful the quality control was during the duplication process, some interpositives will be defective. In addition, modern films do not exactly duplicate the tonality and density range of an original negative. When a defective interpositive is discovered, the original nitrate negative will be available to produce a new interpositive, if it has been properly preserved.

2. Museum Value of Nitrate Negatives. The mission of park museums is to preserve for now and future generations the material culture related to the parks. By definition, therefore, park museum collections are in the business of preserving original materials, the things themselves. An original photograph of whatever medium preserves the historical evidence of the image itself, as well as the physicality, tonality, and "syntax" of the photographic artifact. As the medium of photography changed during its history, so did the photographic artifact. Daguerreotypes differ greatly from albumen prints in their look and feel and the way they communicate visually. Albumen prints convey considerably more visual information than modern black and white prints through the richness of their tonality and density range, a thousand times greater information. The same is true for cellulose nitrate negatives and modern high quality reproductions.

   The principles of context, provenience, and historical evidence dictate the necessity for preservation of archeological artifacts in their context. The same is true of photographic materials. In order to preserve all of the evidence inherent in a photographic artifact, the original must be preserved.

   Any reproduction of an original artifact is an interpretation of the original and not as "true" as the original. Therefore, in order to preserve exactly a photographer's choices and decisions and the uniqueness and exactness of the original information, it is NPS policy to preserve original negatives that show no signs of deterioration.

I. LONG-TERM STORAGE OF ORIGINAL NITRATE NEGATIVES

Long-term storage of cellulose nitrate negatives is a calculated risk under the best of circumstances. Small numbers of negatives can be stored in a freezer or refrigerator. Refrigeration will slow the inevitable deterioration; however, it cannot completely stop it. Refrigeration equipment is subject to failure, with a consequent risk of accelerating deterioration and creating an increased fire hazard. Constant monitoring of storage equipment and periodic inspection of the negatives create an increased workload. Long-term storage means long-term commitment. For many parks, this commitment may not be feasible or advisable. If adequate storage cannot be provided in a park, original nitrate negatives selected for retention may be housed by a National Park Service repository or in cooperation with another institution.

1. Storage Facility and Environment

   As noted under section C of this Appendix, a freezer is the best solution for long-term storage of a relatively small number of nitrate negatives. However, if a park's collection of nitrate negatives exceeds what can be stored in one or two freezers, the negatives should be stored in an isolated cold storage facility.

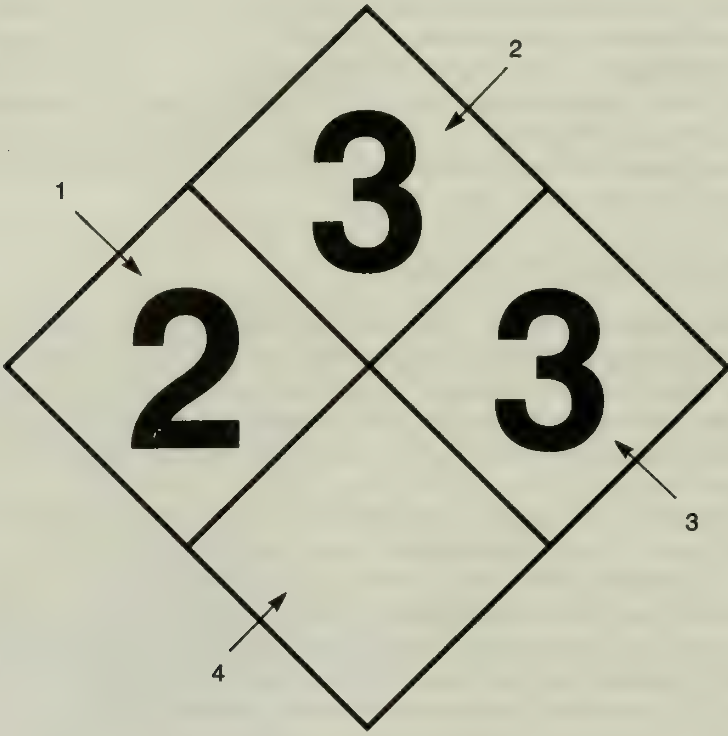
   Large numbers of negatives should be stored in a dedicated facility. The National Fire Protection Association (NFPA) has issued a set of strict standards for the storage and handling of cellulose nitrate motion picture film: NFPA 40-1988: Standard for the Storage and Handling of Cellulose Nitrate Motion Picture Film. The NFPA 40 standard should be applied, with some allowances, to the long-term storage of large collections of cellulose nitrate still picture negatives. Such a facility must meet the following standards:

   a. The space must isolate the negatives from all other collections and must be located away from all employee work areas.

   b. The space must have an environmental control system that maintains a constant low temperature and relative humidity. The temperature should be maintained between 0-15°F and the relative humidity should be maintained between 30-35%. The system should be designed to minimize rapid fluctuations in relative humidity and temperature. Rapid fluctuations will accelerate deterioration of the negatives.

   c. The space must have a fire detection and suppression system. A water sprinkler suppression system is recommended. Because the negatives contain their own source of oxygen, the smothering effect of Halon or carbon dioxide systems would not be effective. Water must be used to cool the fire.

d. Access to this compartment must be kept to a minimum. The door into the space must be posted with the appropriate hazard sign. Refer to Figure M.2 for the NFPA Hazard Warning Symbol for cellulose nitrate. See Chapter 11 for a discussion of the NFPA Hazard Warning Symbol Standard.



1 — Health Hazard (BLUE)
2 — Flammability Hazard (RED)
3 — Reactivity Hazard (YELLOW)
4 — Special Hazard (WHITE)

Figure M.2. NFPA Hazard Warning Sign for Cellulose Nitrate Film

e. Store each negative in its own acid-free buffered negative envelope. If they are to be stored in a cold storage facility, pack the negatives in resealable bags in quantities of 15 to 25 per bag. House bags containing negatives in acid-free boxes in quantities of 50 to 75 per box. If stored in a freezer, house negatives in laminated foil pouches. Refer to Section C of this appendix for further information on the use of laminated foil pouches. This technique facilitates dissipation of the gases emitted from the material. The negatives should be arranged to allow proper ventilation of the gases. **Never reuse negative envelopes that have contained nitrate negatives.**

f. Store boxes of negatives on wire shelving to allow good air circulation and ventilation.

g. Curatorial staff should inspect each negative at least once a year for signs of deterioration. Discard any negatives that show signs of deterioration after ensuring that there is a quality duplicate image.

2. <u>Removal from Refrigerated Storage</u>

Since negatives must be retrieved for visual inspection and use, it will be necessary to remove them from the storage environment. In order to prevent damage from condensation, negatives must be brought up to room temperature <u>slowly</u>. The warm up time required is one to two days, depending on the size of the package. Pouches generally require two to four hours. Negative boxes generally require four to eight hours. Boxes must be sealed in a plastic bag immediately upon removal from the refrigerator. The bag must not be opened until the package has come up to room temperature. When the work is completed, place the negatives back into storage.

J. DISPOSING OF DETERIORATED ORIGINAL NITRATE NEGATIVES

Consult the Regional Curator and the Regional Hazardous Waste Coordinator prior to disposing of any nitrate negatives. Refer to NPS Museum Handbook, Part II, Museum Records for procedures required to document the deaccessioning process.

Do not discard with other waste. The primary method for disposal is to burn deteriorated nitrate film. Dispose of cellulose nitrate film by open burning. Only small quantities at a time should be burned. Never burn them in enclosed furnaces. Enclosed furnaces would allow a dangerous buildup of explosive gases.

Park staff must not attempt to burn nitrate negatives. Consult the park's fire fighting staff or the local fire fighting department for assistance. Fire fighters may accept deteriorated nitrate negatives for use in one of their controlled practice burns.

K. SELECTED BIBLIOGRAPHY

American National Standards Institute
"Technical Standards for Photographic Materials"
(A set of these standards may be purchased. A copy of the catalog of photographic standards may be obtained by writing:

American National Standards Institute (ANSI)
Sales Department
1430 Broadway
New York, New York 10018

Booth, Larry and Jane Booth
1982 "Duplication of Cellulose Nitrate Negatives." Picturescope (Spring), 30:12-18. Rochester, NY: Eastman Kodak Company.

Calhoun, J. M.
1953 "Storage of Nitrate Amateur Still-Camera Film Negatives," Journal of the Biological Photographic Association (August), 21:1-11.

Canadian Conservation Institute
1979 "The Care of Black and White Photographic Collections: Identification of Processes," CCI Technical Bulletin No. 6. Ottawa, Canada: Canadian Conservation Institute.

Eastman Kodak Co.
1985 Conservation of Photographs, Rochester, NY: Eastman Kodak Company.

Hendriks, Klaus B., Douglas R. Madeley, Fred Toll and Brian Thurgood
1986 "The Duplication of Historical Black-and-White Negatives," Journal of Imaging Technology (August), 12:185-199.

Hollinshead, Patricia W.; Ert, Mark D.; Holland, Steven C. and Velo, Kathy
1987 "Deteriorating Negatives: A Health Hazard in Collection Management" (Unpublished Manuscript). Tucson, AZ: Arizona State Museum.

Kopperl, D. F. and C. C. Bard
1985 "Freeze/Thaw Cycling of Motion-Picture Films," SMPTE Journal (August), 94:826-827.

Rempel, Siegfried
1987 The Care of Photographs. New York, NY: Nick Lyons Books.

Ritzenthaler, Mary Lynn, Munoff, Gerald J., and Long, Margery S.
1984 Administration of Photographic Collections. Chicago, IL: Society of American Archivists.

Wilhelm, Henry
1982 "Problems with Long-term Stability of Kodak Professional Direct Duplicating Film," Picturescope (Spring), 30:24-33. Rochester, NY: Eastman Kodak Company.

APPENDIX N. CURATORIAL CARE OF WOODEN OBJECTS

APPENDIX N. CURATORIAL CARE OF WOODEN OBJECTS

A. INTRODUCTION

The key to understanding the behavior of wood and its requirements for long-term preservation is to keep in mind the obvious fact that wood comes from trees. It is necessary to be aware of the physical and cellular structure of wood in the tree in order to understand the reasons why wooden objects react to particular environmental conditions.

Some wooden objects from ancient civilizations, such as the furniture from the tombs found within Egyptian pyramids, remain in almost pristine condition, while other wooden objects seem to rapidly deteriorate. The primary explanation for this phenomenon is the type of environment in which these objects are or were housed.

Park museum collections contain wooden objects in a remarkably wide range of forms and under a wide range of exhibit and storage conditions. There are utilitarian objects such as tools and farm vehicles, religious objects such as icons and altars, as well as furniture that is significant for historical reasons or for decorative art value. A significant percentage of wooden objects in Park Service collections consists of composite objects--objects made of more than one type of material. These composite objects include: frames which house prints, documents, and paintings; musical instruments; rifles; and the machinery of everyday life (e.g., sewing machines and cameras). What these objects have in common is that because they are made wholly or in part of wood, they are susceptible to the same agents of deterioration.

Wooden objects are exhibited in a variety of ways. Furniture is often found in open exhibits in furnished historic structures. Some objects, such as vehicles, totem poles and gun carriages, are often exhibited outside exposed to the weather. The more fortunate objects in terms of preservation are those exhibited within cases in visitor centers and museums. The exhibit context and the nature of the individual object will often influence both the conservation treatment and the ongoing preventive care of the object.

This appendix will deal primarily with the preventive conservation of wooden objects on exhibit and in storage. It will discuss proper environmental conditions and will detail housekeeping procedures. In order to provide an understanding of how and why wooden objects react to the environment and to human intervention, the appendix includes: a discussion of the nature of wood; the typical fabrication techniques of wood objects, furniture, and associated materials; and the types of deterioration that affect objects made of wood.

A key factor for the park curator in providing proper on-site care to objects is in knowing how far to go. At what point is it preferable to hold off and seek the advice of a conservator? For this reason, the appendix will include a discussion of the means by which the condition of wooden objects can be assessed. In addition there is a discussion of

what the conservator can do to preserve and perhaps restore the historical integrity of a wood object once it has deteriorated because of improper environment or care.

B. THE NATURE OF WOOD

Wood is an organic material. The behavior of wooden objects in relation to their environment can be best understood through an understanding of the nature of wood in the living tree.

A tree can be viewed as a bundle of vessels, the walls of which are comprised of cellulose, glued together with lignin. The growth of new cells takes place around the circumference of the tree, forming a ring just within the bark layer called a <u>cambium</u>. Generally, in temperate zones, a growth ring is comprised of an <u>earlywood</u> and a <u>latewood</u> layer which roughly correspond to spring and summer growth. These layers usually can be distinguished visually, the latewood layer being darker and denser.

Wood cells are quite long in relation to their width. The cells of the vessel walls are oriented parallel to the long axis of the tree and branches. The hollow cavity within each vessel is called a <u>lumen</u>. It is through these lumens that water is transported from the root system to the leaves. Trees also have a smaller number of cells which extend out from the center of the main stem or <u>pith</u> to the bark on the horizontal plane, perpendicular to the vessels, forming <u>rays</u>. Rays are extremely thin bands, often no more than a few cells thick, which store and transport food horizontally in the tree.

The term "grain", repeatedly used in any discussion of trees or wood has come to mean a variety of things. In this appendix, unless otherwise noted, grain will refer to the direction of the vessels. Thus, "cross grain" refers to the horizontal plane and along the "grain" refers to the long, or vertical axis of the tree. This distinction is important for understanding how wood responds to changes in relative humidity.

When cutting into a tree or looking at a log on end, two different zones within the wood can be observed. The outer zone is called <u>sapwood</u> and the inner zone is called <u>heartwood</u>. The size of each zone in relation to one another will vary, depending on the species and age of the tree. The band of sapwood in mature trees ranges in width from only a few growth rings up to six to eight inches. The zones usually are discernable from one another by color. The sapwood is always light in color, while the heartwood is darker. The heartwood's particular color depends on the species. Figure N.1 illustrates a typical cross section of a tree's stem.

In the living tree, sapwood and heartwood serve distinct functions and have different characteristics. These characteristics also influence the behavior of wood once it has been fashioned into objects. Sapwood is comprised primarily of living cells which transport sap or water to the leaves and store nutrients. New growth forming just to the inside of the bark layer is sapwood. Toward the center of the tree the sapwood cells die and become part of the heartwood. Associated with the transition to heartwood is the formation of <u>extractives</u> within the cell walls. It is these extractives which give the heartwood its color as well as other

characteristics such as durability, flammability and dimensional stability.

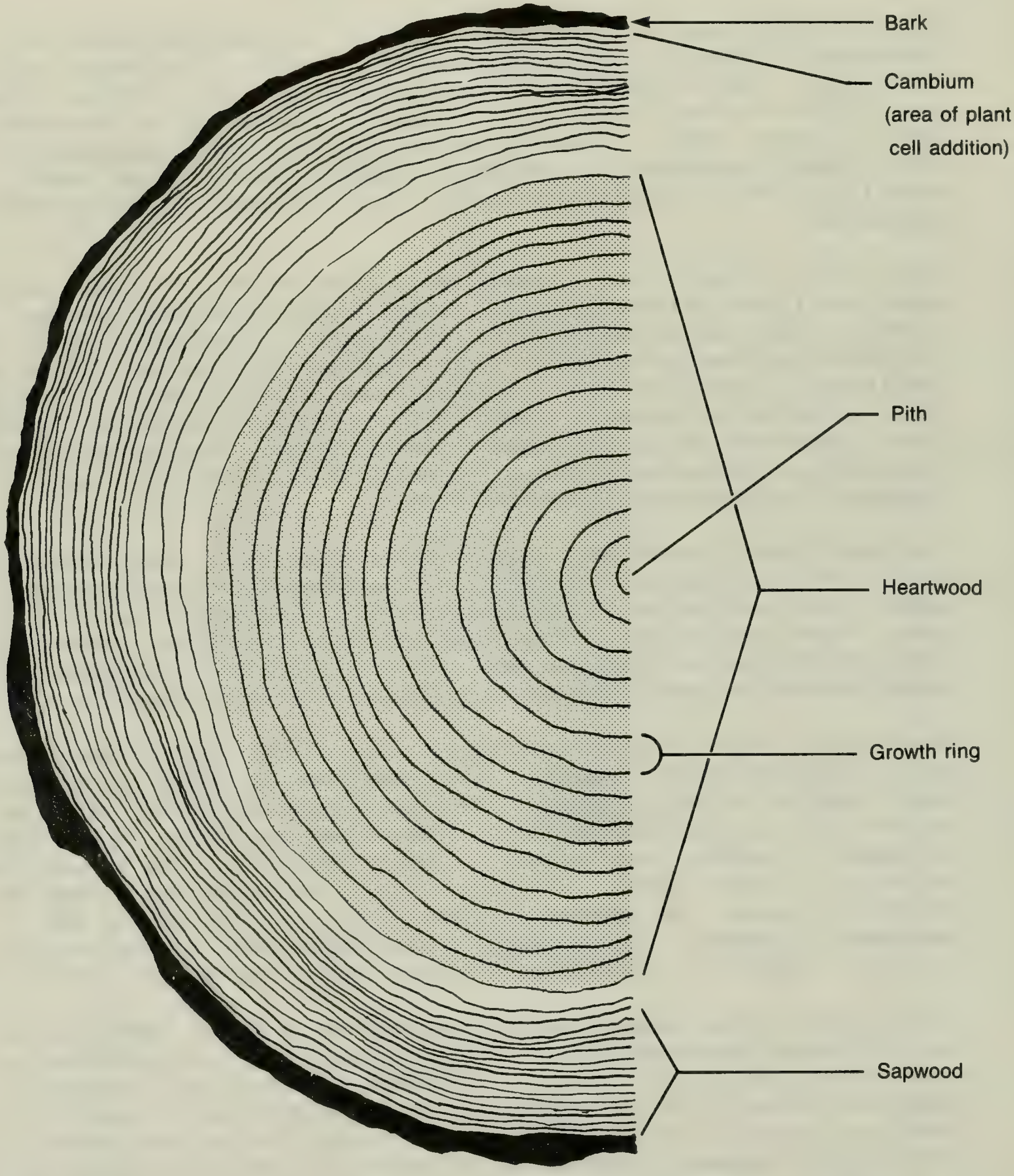


Figure N.1. Typical Tree Stem Cross Section

While sapwood is necessary for the life and functioning of the tree, the primary role of heartwood is to provide mechanical support for the living tree. Trees can survive without heartwood, as evidenced by the many hollow trees where heartwood has been eaten away by insect and fungal attack. The sapwood in the living tree has biological defenses against this type of deterioration. However, once the tree is dead, either from natural causes or harvesting, these defenses are no longer in effect and the sapwood becomes vulnerable. In many species the chemical defenses found in the extractives help protect heartwood lumber from biological attack. Lumber comprised of sapwood has no such protection. This explains why, when sapwood is used in the construction of wood objects, it may show evidence of insect infestation or staining from fungal activity while the neighboring heartwood is free from damage.

A tree, and consequently wood from it, can be viewed as having three faces or planes: the <u>cross</u> (or transverse) <u>section</u>, the <u>radial</u> <u>section</u>, and the <u>tangential</u> <u>section</u>. Figure N.2 illustrates the three planes of wood.

The easiest plane to observe is the cross section. It is the surface that is exposed when cutting directly across the trunk of a tree. The pith, the concentric growth rings around the pith, the sapwood, and the bark layer are visible on a full cross section of a tree stem. Commonly referred to as end grain, this surface has been compared to the top of an open box of straws because the cell cavities are exposed. Like the top of a box of straws, water is more readily absorbed and given off on this plane than the other planes. End grain surfaces are characteristically harder and more likely to split. Large areas of end grain are generally not left exposed on furniture because it remains porous and does not take stain and finishes well.

The second plane, referred to as the radial plane, extends along the long axis of the tree and from the bark to the pith. Growth rings are more or less perpendicular to the radial plane. Therefore the grain pattern on a radial surface is usually straight and regular. It is referred to as vertical or edge grain. As mentioned, ray cells grow from the pith to the bark along the radial plane. The effect of these cells is to make boards sawn on the radial plane more dimensionally stable and less likely to distort in response to changes in ambient relative humidity. Where these characteristics are of particular importance, for instance on the sound boards of musical instruments, wood was likely to have been sawn out in the radial plane. Radial surfaces are also characteristically less susceptible to damage from abrasion and weathering. Not surprisingly, a good deal of wood flooring and siding was traditionally sawn on the radial plane.

The third plane, the tangential plane, extends along the long axis of the tree and forms a tangent with the concentric growth rings. Boards sawn along this plane are not restrained by ray cells and characteristically respond dimensionally to changes in relative humidity at almost twice the rate of radial sawn boards. A wood surface which falls between a true radial plane and a true tangential plane is often referred to as <u>longitudinal</u>.

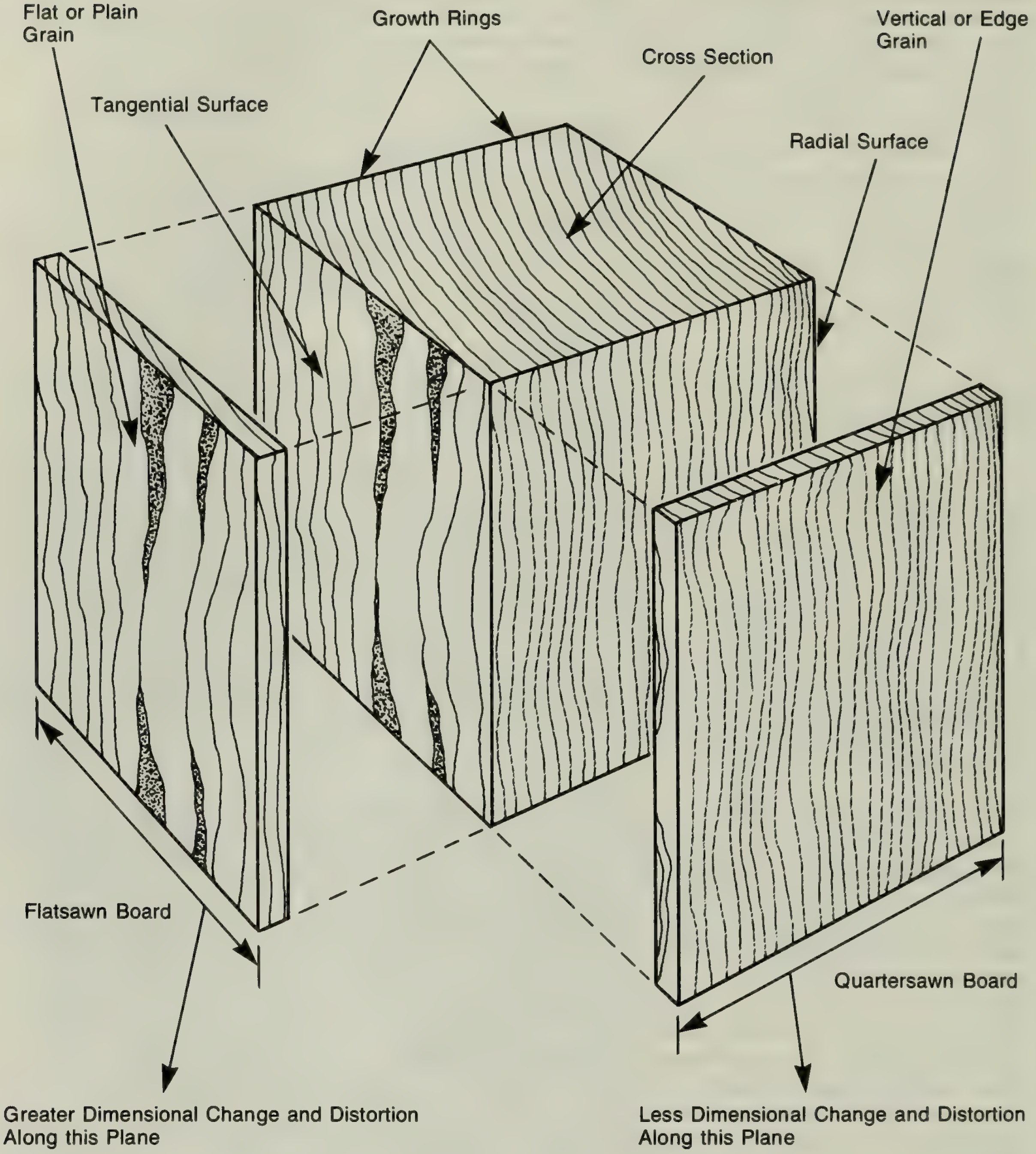


Figure N.2. The Three Principal Planes or Surfaces of a Typical Block of Wood: Tangential, Radial, and Cross Section

The Wood and Water Relationship

A living tree contains a tremendous amount of water. In fact, freshly cut or green wood commonly contains more than 100% of its dry weight in water. There is a very strong molecular attraction between water and the cellulose in wood. This property is called hygroscopicity. Wood remains hygroscopic even after the tree is felled and cut into lumber.

Water in freshly cut wood is found in both a free and bound state. The water found in the vessel cavities is called free water and water that is found in the cell walls is bound water. As newly felled or green wood dries, it gives up its free water first. The point at which the cell walls are still saturated and fully swollen and the tree water has evaporated is called the fiber saturation point. At this point, the wood has not started to shrink. The moisture content at fiber saturation point, expressed as the ratio between the weight of water in a given volume of wood and the weight of that volume in an oven dry state, varies from 25% to 30%.

Wood will respond dimensionally to changes in ambient relative humidity when its moisture content is below the fiber saturation point. The degree to which wood dries below the fiber saturation point depends on the relative humidity level of its environment. If the relative humidity were to stay at 100%, the moisture content would remain in the 25%-30% range and the wood would not shrink. Normally air dried wood will reach a moisture content of between 10%-12%, depending on the climate in which it is dried. Wood which is kiln dried (i.e., dried in a controlled environment) is brought to about 7% moisture content at which point it is fashioned into furniture and objects. **However, it is important to remember that kiln dried wood will absorb water vapor if placed in an environment with high relative humidity.**

Given sufficent time, **wood will arrive at an equilibrium with its environment--a state in which it neither takes up or gives off moisture.** There is a direct relationship between the moisture content of wood and the relative humidity level in the surrounding air. This is significant, for so long as the RH remains constant, the equilibrium moisture content will not vary and dimensional stability will be maintained. Refer to Figure N.3 for a graph that illustrates the relationship between relative humidity and equilibrium moisture content in wood. This graph can help to calculate with the appropriate formula the amount of contraction or expansion that may occur in wooden members of furniture and other wood objects.

As relative humidity levels rise, wood absorbs water vapor from the air and expands. As relative humidity levels fall, wood gives off water vapor to the air and contracts. It is the cell walls which expand and contract during this process. The cell length remains virtually unchanged. Thus, dimensional change in wood is not uniform in all planes. Along the longitudinal plane, parallel to the long axis of the tree, movement is negligible (about .1%). However, across the longitudinal plane, perpendicular to the long axis of the tree, the extent of dimensional change is significant. In the tangential plane, dimensional change

averages about 8% and in the radial plane, where movement is constricted by ray cells, the dimensional change averages about 4%.

This difference in the dimensional change in wood in its various planes can be seen in many museum objects. Typically the rim of a turned bowl will, over time, move out of round becoming somewhat oval in shape because of the diffence between tangential and radial shrinkage. For the same reason, turned feet become oval and square legs take on a diamond shape on many pieces of furniture. Rungs and stretchers may become loose in chair legs because of the differential in shrinkage along and across the grain. Veneered surfaces may split or buckle because the grain orientation of the veneer is different from that of the underlying wood.

The actual extent of dimensional change varies somewhat from species to species, making some kinds of woods more desirable in the fabrication of furniture and wood objects. Some of the more stable woods include teak, mahogany and redwood. Walnut and cherry, two popular native furniture woods, fall in the middle of the range.

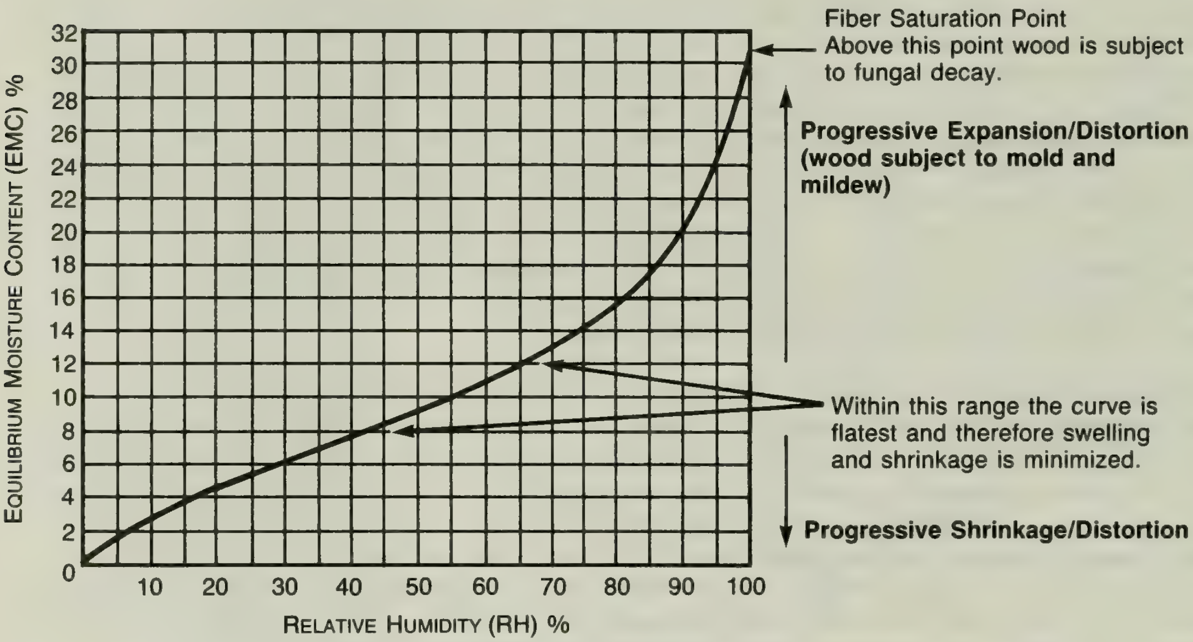


Figure N.3. Graph Illustrating the Relationship Between Relative Humidity and Equilibrium Moisture Content of Wood

C. AGENTS OF DETERIORATION

In nature wood decays. When a tree branch falls to the forest floor, it is soon attacked by physical, chemical, and biological agents which break it down and return it to soil so as to provide nutrients for a new generation. To an extent, the attempt to preserve wooden objects for perpetuity is an exercise in reversing the natural order. The same agents of deterioration which turn a tree branch to humus can, if conditions are favorable, promote the demise of a prized chair or carriage. The best means of preserving wooden objects is to minimize the effects of the agents of deterioration.

1. Physical Deterioration

a. Shrinking and Swelling

Wood is hygroscopic. It will respond to changes in the ambient relative humidity--swelling as RH rises and shrinking as RH falls. Wood is also anisotropic. This means that the shrinking and swelling is not dimensionally uniform. Therefore, as a board loses moisture during the initial seasoning process or changes moisture content in an atmosphere of fluctuating RH, there is a tendency for it to become distorted or warped. The particular type of distortion, (e.g., cup, bow, twist or diamonding) will usually depend on the shape of the board and the orientation of the wood cells in relation to that shape.

Cupping, a deformation across the width of a board, is often observed on wide, unrestrained boards such as might be found on the leaves of a drop leaf table. This form of warping can occur in the initial seasoning or later on in the life of an object. The cupping of a board is sometimes due to the fact that a finish has been applied to one surface only. The finish slows the migration of moisture to and from the atmosphere. Typically the exterior surface of the leaf of a drop leaf table will develop a concave cup as the interior surface more readily absorbs moisture from the environment in an atmosphere of rising RH.

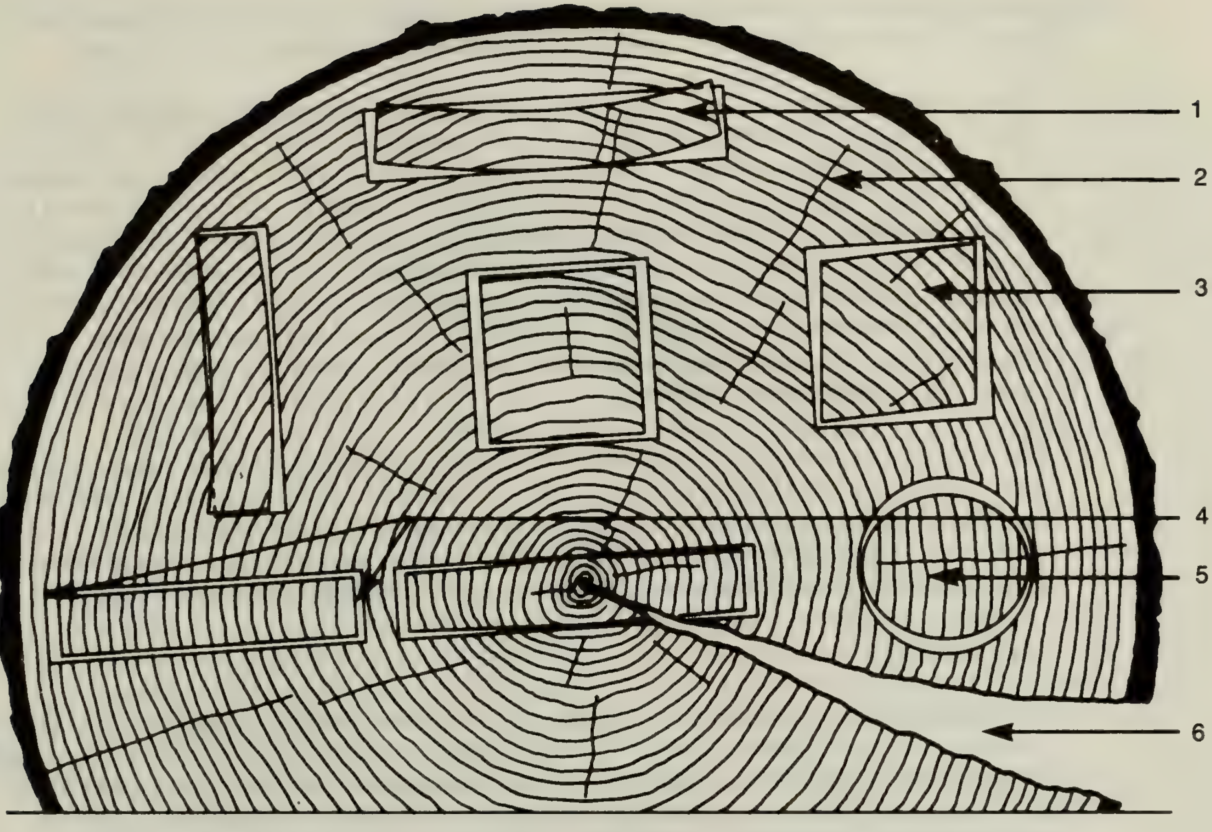
Cupping also occurs when there are different microclimates present at opposite surfaces of an object. This situation occurs quite commonly within furnished historic structures. For example, the closed leaf of a drop leaf table placed close to a south facing window will be exposed to a higher RH level in the cooler, shaded interior of the table than on the surface that receives the heat rays of the sun. The two surfaces of the board will have a different equilibrium moisture content and cupping will often result. A similar circumstance occurs if one side of an object faces an artificial heat source such as a wood stove or hot air register.

Stresses from uneven shrinkage can result in separation of cells along the grain. These separations, which usually occur at the

end grain or near the surface, are referred to a <u>checks</u>. They occur principally because the cells at and near the end grain give up moisture faster than the cells in the interior. Checking usually occurs during the initial seasoning; however, it also can occur if the relative humidity drops rapidly. Checking can sometime be observed on the exposed end grain edges of table tops or the front edge of the seat of a Windsor chair. Some checks extend only a small distance in from the end of the board and do not continue through its full thickness, thereby causing only visual damage to the object. If, however, the check extends more than an inch or so into the board, or the grain orientation is not parallel to the edge of the board or the check continues through the full thickness of the board, there is a likelihood that the checking has caused structural damage to the object. As a result, the object may require conservation treatment.

<u>Radial cracking</u> is another form of deformation caused by the anisotropic nature of wood. When a disk of green wood is cut off the end of a log and allowed to dry, almost invariably, a crack will develop from the pith to the bark edge. This results in a pie shaped opening which relieves the stress caused by the differential in shrinkage between the radial and tangential planes. Objects which, because of their shape, must be made of wood members having a wide cross section, are usually brought from the green state to the dry state very carefully over a long period of time. Even though they may not exhibit radial cracking, they retain the stresses and remain prone to this type of damage. Thus, such objects as large turned bowls and three dimensional sculpture are particularly sensitive to fluctuations in relative humidity. Refer to Figure N.4 for illustration of shrinkage and distortion of wood as it dries from the green state or responds to changes in ambient relative humidity.

An unrestrained board, with straight grain and without growth defects can usually withstand moderate fluctuations in relative humidity without damage. However, when that board is restrained at its edges or connected to other wood members which are not oriented in the same plane, the same degree of fluctuation in RH can be damaging. Since wood objects, and particularly furniture, are often constructed of various members connected in cross-grain joinery, this type of damage is common. It is occasionally seen on the sides of chests of drawers, where the horizontal drawer guides are nailed or screwed close to the edges of the sides, restraining the movement of the sides across the grain. The stress can be strong enough to cause the side board to split.



1. Cupping
2. End grain checking
3. Diamonding
4. Cross grain shrinkage
5. Distortion of cylindrical form
6. Radial cracking

Figure N.4. Characterictic Shrinkage and Distortion of Wood (Viewed from the Transverse Plane)

b. Weathering

Although more commonly a problem associated with structures, wooden artifacts housed outdoors are subject to physical erosion from the action of rain and wind driven particulates. Because biological decay usually proceeds at a faster pace, the effects of weathering may not always be evident except in drier and colder environments less conducive to biological decay and on resistant

wood species. The erosion process generally will not remove more than ¼" of unprotected wood surface every century.

The weathering process includes physical and photochemical degradation. Characteristically, the wood surface takes on a silver-gray color and a striated texture as the softer earlywood wears away leaving exposed the harder latewood. The ultraviolet component in sunlight light breaks down the lignin in the cell walls which is then physically washed away by the action of rain. The typical silver-gray surface is only a few millimeters thick and is composed of partially degraded cellulose and micro-organisms. It is somewhat more resistant to biological attack than non-weathered surfaces.

Many objects now housed indoors in museum collections were exposed to outdoor conditions during their "useful" life and exhibit this weathered appearance. So long as fungal and insect damage is not present, this condition can be considered stable and the weathered appearance should be preserved as part of the historical evidence.

c. Human Abuse

Perhaps the most damaging form of physical deterioration is human abuse. It is sometimes difficult when examining an object to make a clear distinction between human abuse and period use. This is particularly true in park museum collections of wood artifacts which are significant because of their historical association rather than their fine or decorative art value. In general, signs of historic usage are preserved because this evidence relates information about the object and the people who used it. Examples of this evidence of historic usage include the abraded wood rim of a Civil War drum from Gettysburg or the ink stains around the inkwell of a 19th century government desk from Salem Maritime. Once the object enters a museum collection, any further deterioration should be viewed as a form of abuse.

Physical damage to wood objects in museum collections can result from improper handling and housekeeping procedures and poor storage or exhibit conditions. The likelihood of this type of damage occurring is greater in collections exhibited in furnished historic structures where the objects are exposed to more soils and dust in the environment and therefore require more frequent hands-on housekeeping.

Another common cause of damage to wooden objects is poorly executed or inappropriate repair. Repairs to joinery using nails can split the wood and mar the surface. Glued repairs may result in misaligned surfaces and glue residue on finishes. Evidence of original finishes is often removed by overzealous and improper refinishing techniques. Wood surfaces often are scratched by coarse abrasives. In addition, irreversible materials are often

used in repairs, making future conservation treatment considerably more difficult, if not impossible.

2. Chemical Deterioration

a. Light

Light causes deterioration of the cellular structure of wood, breaks down the lignin component, and bleaches its colors. Its effect is particularly evident on darker colored woods, such as walnut, mahogany and rosewood. Although all light causes damage, the most harmful component of light is ultraviolet (UV) radiation. Since it is invisible to the human eye, removing this part of the spectrum does not diminish the visible light level available to view the object.

Light damage to wooden objects in furnished historic structures is most commonly caused by high levels of sunlight. Furniture often will exhibit damage on the surface that faces a window. In some historic structures it is common to place a smaller object (e.g., vase) on the top of a table that is located near a window. The result is an island of original color in a sea of bleached wood. The object has shielded the underlying wood from light exposure.

Wood also can be damaged by excessive artificial light used to illuminate exhibits. In addition, wood can be damaged by heat build up resulting from high levels of artificial light or sunlight. Heat build up is a special problem if lighting fixtures are placed inside an exhibit case.

b. Acids, Alkalies, and Salt

Acids may cause deterioration of the cellulose in wood, resulting in embrittlement. Wood objects housed outdoors are exposed to a worsening problem due to acid rain. Alkalies or bases degrade the hemicellulose and lignin component of wood and cause the wood to defibrate or separate into individual fibers. Wood is generally more susceptible to damage from alkaline solutions than acidic solutions. Heartwood is more resistant to chemical deterioration than sapwood.

Exposure to salts also can result in defibration of the wood tissue. Although rarely encountered, this type of damage is observed on objects used in food preparation and storage, such as the wooden bucket of an early 20th century ice cream maker.

c. Fire

The most dramatic, and by far most damaging, form of chemical deterioration of wood objects is fire. This subject is addressed in Chapter 9 of this handbook. Wood is a readily flammable material. Park curatorial staff should implement measures to

prevent fire in museum spaces and to ensure that the risk of fire is addressed in the park's Emergency Operation Plan.

3. Biological Deterioration

Wood is subject to deterioration from a number of biological agents, including bacteria, fungi, insects, and vertebrate animals. Biological damage to wooden museum objects often occurs before the object is placed in the museum setting. It may happen when the object is in an outdoor environment, or even before the wood from which the object is made is sawn into lumber. Although certain types of biological damage are unlikely to occur in the museum environment, an awareness of the possibilities is helpful because the potential of damage may influence the nature of curatorial care.

a. Bacteria

Bacteria generally will affect only wood fully saturated with water. Bacterial attack results in increased permeability and a modest reduction in the strength of wood. The ray cells are attacked first and the stored starches are consumed. Cellulose can eventually be degraded. Bacterial attack is not a major factor in affecting the condition of wood objects in most museum collections, except in so far as it makes the wood more vulnerable to some types of fungal activity.

b. Fungi

Fungal activity is the single greatest cause of biodeterioration of wood. Fungi are simple plants which, because they have no chlorophyll, must live off other organic material. The plant consists of thin, thread-like material, called hyphae which mat together to form mycelium, and fruiting bodies which produce spores. The spores are produced in great numbers and are found in almost all environments. There are three major categories of fungi which affect wood: mold fungi, stain fungi and decay fungi.

1) **Mold fungi** live principally on the surface of wood. This type of fungus discolors wood. However, it does not consume cellulose and, therefore, does not affect the strength of wood.

2) **Stain fungi** invade the cell structure of sapwood, living primarily off of stored carbohydrates. It is not unusual to see a board in which the sapwood shows evidence of fungal attack while the heartwood remains untouched due to the presence of fungi resistant extractives.

3) **Decay fungi** actually consume the cellular structure of wood causing a loss in strength which may lead to total deterioration. The wood cells are broken down by enzymes produced by these fungi. There are two major types of decay causing fungi: brown rot and white rot. The white rot type

consumes both lignin and cellulose, causing the wood to lose color and crack along the grain. Brown rot fungi consume only cellulose, leaving a brown color and checking both along and across the grain. This type of fungal attack causes abnormal shrinkage of the wood tissue. Brown rotted wood looks like and is often mistaken for fire charred wood. In an advanced state, wood attacked by decay fungi exhibits loss of weight, color and strength. It has a dead sound when struck, smells "rotten", is friable, and often has a wet surface because the fungi produce moisture.

Fungal spores are found in the air in virtually all environments. It is practically impossible to keep wood objects isolated from contact with fungal spores. However, the spores require the presence of air, heat, moisture, and nutrients in order to germinate. Preventing fungal growth in spaces housing collections, depends on controlling these conditions.

Fungi, unlike bacteria, need oxygen to grow. More than 20% volume of air in wood is required. For this reason, submerged and waterlogged wood is free from fungal decay. Sawmills will sometimes store their logs in ponds prior to cutting so as to prevent fungal growth. The most accommodating temperature for fungal growth is in the range between 50-90°F. Below 35°F and above 100°F, growth of most fungi types effectively stops.

Moisture content of the wood is also a critical factor. Decay fungi will thrive only when the moisture content is at or above the fiber saturation point of about 30%. High levels of relative humidity will not bring the moisture content beyond the fiber saturation point. Therefore, previously dried wood (as would be used in most objects) is at risk from decay causing fungi only if it is in contact with water in its liquid form. However, it should be noted that mold and stain fungi will grow on the surface of wood which is below the fiber saturation point. High relative humidity can cause mildew and staining of sapwood, but the presence of water from ground contact, rain, condensation or other factors is necessary to promote the growth of decay causing fungi.

The availability of suitable nutrients is necessary for the growth of decay causing fungi. The sapwood of all species readily provides those nutrients. The heartwood of some species (e.g., cedar, redwood) contains resistant extractives which help to protect it from fungal and insect attack.

c. Insects

Wood is subject to insect attack in its living stage and after it has been fashioned into objects. The damage can be caused by insects actually feeding on the wood or simply excavating it to

provide shelter. The insects that most commonly cause damage to wood include beetles, termites, carpenter ants, and carpenter bees. Refer to Chapter 5 of this handbook for a discussion of biological deterioration and integrated pest management.

1) **Beetles**

In the temperate climates of the United States, it is the various wood-boring families within the Coleoptera Order, commonly known as beetles, which do the most damage to furniture and wooden objects. The adult lays its eggs in pores or checks in the wood surface. After the eggs hatch, the larvae excavate tunnels through the interior of the wood, eventually pupating, boring a hole to the wood surface, and flying off to mate and start the cycle again.

Beetles may be present in a wooden object for a long period of time. Their activity may remain undiscovered until the adult bores the flight hole and escapes, pushing a fine sawdust like material called frass out of the hole. The larval stage can last from one to approximately ten years depending on the particular species of beetle and on environmental conditions. The larval stage generally will last longer in more hostile environments (e.g., colder and dryer).

Beetles are more likely to attack wood in an environment of high relative humidity. Certain species will invade only that wood which has first been degraded by fungal attack. Most beetles, however, are able to exist in a wide range of temperatures and relative humidity.

The most common beetle which attacks furniture and wood objects in North America is the powder post beetle belonging to the Lyctus family. Refer to Chapter 5 for the life history of this insect.

2) **Termites**

Other types of insects are a lesser problem in so far as wooden objects are concerned. Termites do considerable damage to stationary structures. However, in North America the damage they do to movable wood objects is limited.

The species found over much of North America is the subterranean termite. Refer to Chapter 5 for the life history of this insect.

Drywood termites do not require contact with moisture or the ground. They, therefore, can infest dry wood without forays outside and thus potentially pose more of a menace to wood objects than do subterranean termites. Species of dry wood

termites are found on the southern coastal rim of the United States and in the warmer areas of the West Coast.

3) Carpenter Ants

Carpenter ants are another insect which can attack wood. It is the adult carpenter ant that does the damage. Unlike the termite, the ant does not feed off the wood but rather excavates chambers to provide shelter for the colony. The damage can be quite extensive.

4) Carpenter Bees

Carpenter bees are solitary insects which bore large chambers in which to lay their eggs. They may return year after year and elongate the chambers. These insects, like the carpenter ants, do not consume cellulose. Carpenter bees will bore chambers in sapwood or heartwood.

d. Marine Organisms

Although a problem only for a limited number of museum objects, marine organisms are a significant factor in the preservation of wooden ships and other underwater artifacts and for those museums that house wooden artifacts which have been underwater. Shipworm and gribble are two of the most destructive marine organisms. Gribble, a crustacean about 1/8" long, generally tunnels close to the surface of the wood, making narrow channels. The shipworm is a mollusc which is considerably larger in diameter and length. It lives off of wood and plankton, making channels up to 2.5 cm. in diameter. Objects which have been infested with shipworm are generally extremely fragile.

e. Birds and Mammals

The birds most destructive to wooden objects are the woodpeckers. They are drawn to wood which may have insect infestations and use their powerful beaks to chip away the overlying wood exposing the insects.

Rodents damage wood by their gnawing. They gnaw either to get food and salts from the surface of wood or to get through to the food stored in the wood. There are numerous objects, like pie safes and jelly cupboards, in museum collections which have large holes through their backboards caused by hungry rodents. Wooden food vessels, both ceremonial and utilitarian, are also subject to rodent damage. These objects are most vulnerable when the remnants of food remain on the surface and in the pores.
The decision to remove these remnants is a difficult one, because they may provide important evidence of historical or cultural usage.

D. THE NATURE OF FURNITURE

Most furniture serves more than a functional purpose. The maker or designer intended the object to appear a certain way, to conform to the accepted fashion of the era in which it was made or possibly to the artisan's own unique vision. While some furniture is primarily aesthetic expression and other furniture is almost exclusively functional, generally speaking, it is made to serve both a functional and a decorative purposes.

Under most circumstances the conservator and the curator do not seek to preserve the functional aspect of furniture, because this is generally not significant once the object is in a museum collection. It is the decorative and historical aspects of the object which usually warrant preservation. The emphasis placed on the preservation of either of these aspects will vary depending on the nature of the collection and the significance of the object.

Almost all furniture is made from multiple wood members which are joined together in some fashion. Often the members must be joined in such a way that the different wood planes interconnect in a manner that accommodates the strength and dimensional characteristics of wood. This is referred to as cross grain joinery.

The wood members are held together by mechanical means using various types of fasteners or by cutting the wood members themselves into configurations where they mate and interlock. Wood members are also joined by the use of glues and adhesives. A typical piece of furniture will incorporate a number of joinery techniques. Historically the type of joinery used has reflected the technology, fashion and economics of the period.

In addition to hardware and adhesives, a typical piece of wooden furniture will have a finish. The finish, like the object itself, generally has a functional and decorative role. It serves to protect the wood surface and to enhance it visually. Historically, numerous types of finishes have been used, including paint, varnish, shellac, lacquer, metal leaf and wax.

Some furniture incorporates fabric covering over a wooden framework. The fabric is generally used for fashion as well as comfort. Seating furniture comprises the bulk of upholstered furniture (e.g., chairs, sofas and settees). The upholstery is made up of an outer fabric, a stuffing and a support. Traditional upholstery fabric included protein materials such as silk and horse hair, and cellulosic materials such as linen and cotton. The conservation and curatorial care of upholstered furniture combines textile conservation procedures and practices with that of furniture conservation. Upholstery conservation, as a separate specialty, has just recently emerged.

1. Joinery

One of the most common and earliest joints used in furniture construction is the mortise and tenon joint. In simple terms a hole is chiseled into a piece of wood (the mortise) and a projecting end of

another piece of wood (the tenon) is inserted into the hole. There are numerous variations to the basic joint. The wood members connected by this joint are, almost without exception, at cross grain to one another. The end grain of the tenon is inserted into the side or longitudinal grain of the mortise. This technique can be the source of problems because of the differential degree of expansion and contraction of wood in different planes. Most traditional cabinet makers had a good empirical knowledge of the characteristics of wood and took this differential into account, making the tenons slightly smaller in width than the mortise. This prevented the tenon from expanding beyond the capacity of the mortise and crushing itself or splitting the mortise.

Mortise and tenons are held together in a variety of ways. Historically, glue was most commonly used in the construction of more sophisticated pieces. In country pieces and where the object was to be placed outdoors or where it was part of a structure, the most common technique was to drive square wood pins into round holes drilled through the joint. This technique depended on the friction of square corners cutting into the round sides of the hole to keep the joint together. Figure N.5 illustrates a typical mortise and tenon joint.

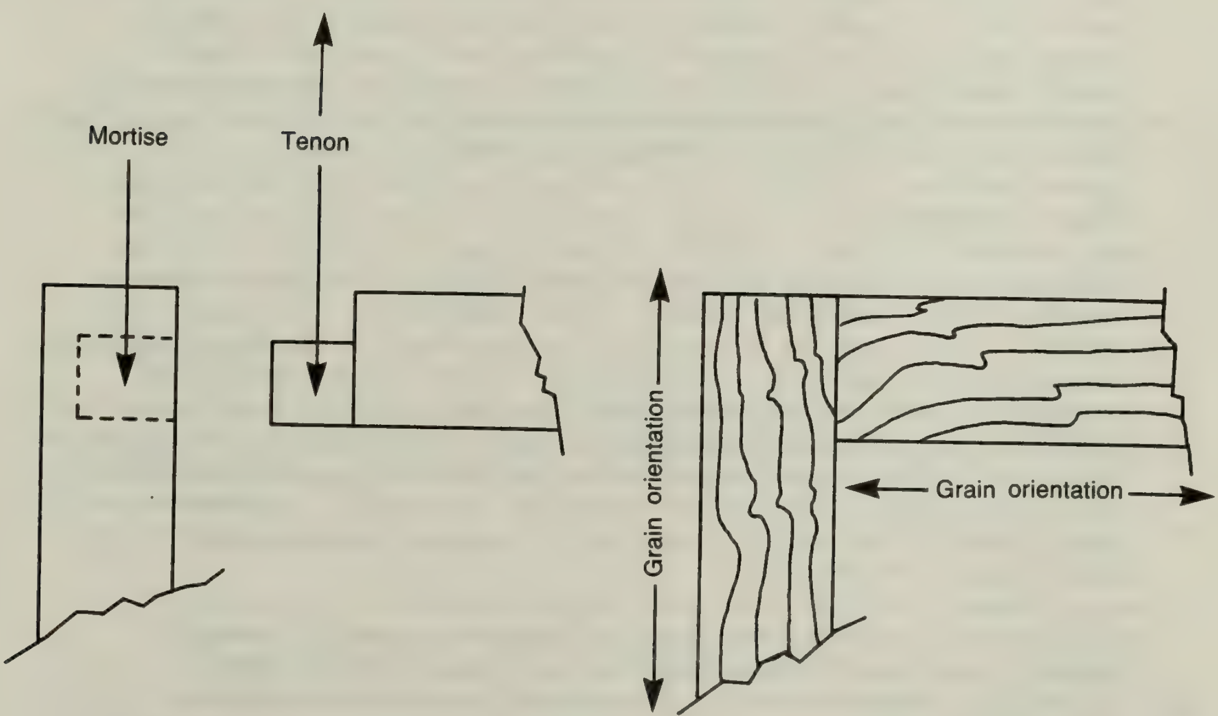


Figure N.5. Typical Mortise and Tenon Joint

A great deal of period furniture, as well as architectural elements, employed frame and panel construction. This technique enabled the cabinetmaker to make stable wide elements and avoid the splitting that often results in construction using wide boards constrained at their edges. The frame is made from relatively narrow members joined at the corners with mortise and tenon. The inner edge of the frame is grooved to receive the edges of a wide panel. The panel is free floating within the grooved enclosure, occasionally attached at its center to the top and bottom of the frame with a single nail or a small amount of glue. This allows the panel to move unrestrained across the grain with fluctuating relative humidity. The development of this technique greatly expanded the possibilities of furniture design.

As with many techniques, this one has sometimes been used in such a way that its initial intent is nullified. For example, in some period furniture the panel is glued all the way around its edges, making either glue failure or splitting of the panel likely if the relative humidity fluctuates greatly.

Another traditional technique is the dovetail joint. It is generally used to join the edges of boards. Here the boards are joined in a parallel alignment so that wide boards can be connected to one another without danger of splitting. The edges of the boards are cut and chiseled in such a way that they mechanically interlock. Dovetail joints were commonly glued together. This kind of joinery was typically used to connect the sides of drawers and chests. Except on relatively unsophisticated pieces, dovetails were traditionally not intended to be seen, unlike on the furniture of today where its labor intensive requirements denote quality. Figure N.6 illustrates a typical dovetail joint.

2. Metal Fasteners

Various types of metal fasteners have been used in furniture construction, including nails, screws and bolts. The amount and variety have steadily increased as technology has enabled the mass production of hardware. For example, there was a significant increase in the use of nails when the technology to manufacture nails from bar stock was developed in the late 18th Century. There was an increase in the use of screws when the technology was developed to manufacture them with gimlet points in the 1840's. Hardware can be a useful tool in dating of furniture since most developments in its manufacture are recorded.

Fasteners are most commonly made from ferrous metal. However, copper, brass and plated examples were occasionally used. Unprotected ferrous metals can corrode in environments with high relative humidity. If allowed to proceed, this corrosion can cause damage to the appearance and the structure of the wooden object. Severely corroded metal will expand crushing and splitting the surrounding wood. This phenomenon is known as corrosion jacking. It

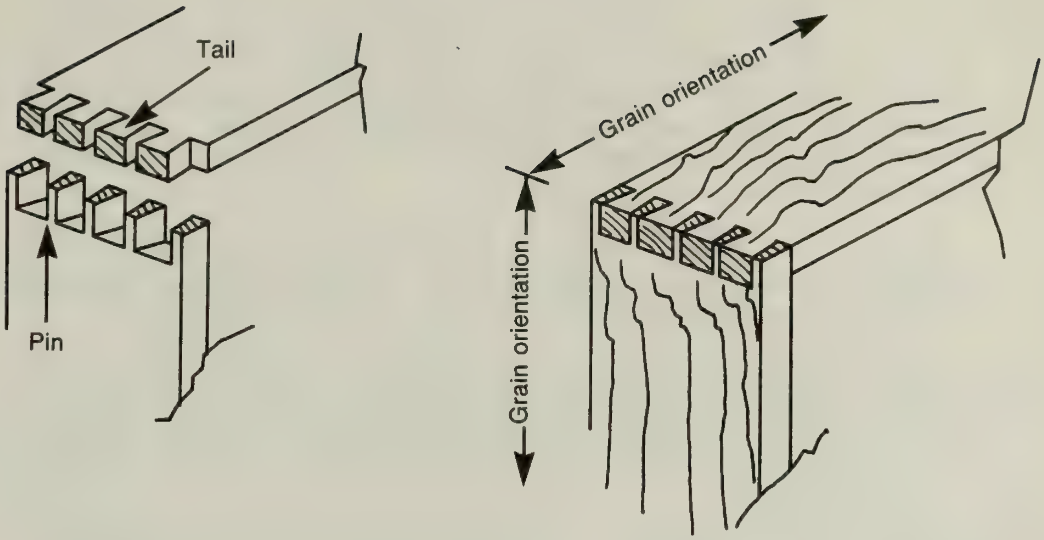


Figure N.6. Typical Dovetail Joint

is most likely to occur to objects at coastal sites where there is exposure to salts in the environment. Iron salts are often present at contact points between wood and ferrous metals. These salts degrade and discolor wood in the vicinity of the corroded metal. Woods with high tannic acid levels (e.g., oak) are particularly susceptible to this type of deterioration. Contact between some woods and metals also will accelerate the oxidation of the metal.

3. Adhesives

Adhesives may be used alone in making the connection or they may be used in conjunction with metal fasteners or mechanical wooden joints such as the mortise and tenon.

a. Protein-based glues

Historically, protein-based glues were the most commonly used in the fabrication of wooden objects. The primary ingredient of protein-based glues is animal products. There is pictorial evidence that these glues were used by the Egyptians nearly 4000 years ago. Most protein glues are water soluble. Two varieties which were frequently used are hide glue and fish glue. Traditionally these glues required heat to put them in a gel state prior to use. The glue sets as it cools and the water content

evaporates. Although not as strong as many of the modern synthetic adhesives, traditional protein based-glues, if properly formulated and properly applied, generally formed a stronger bond to the wood than the wood to itself.

In a proper environment, protein glues can remain effective almost indefinitely. However, both extremes of relative humidity can cause a glue joint to fail. The presence of water in the liquid form or extremely high relative humidity will dissolve the glue. An extremely low relative humidity will desiccate the glue and cause the joint to fail. These glues are also susceptible to insect attack, particularly from the protein-eating insects in the beetle family.

Because this type of glue is readily resoluble and has a long setting time, it is commonly used in the conservation treatment of furniture and other wood objects.

Casein glue, a protein-based glue made from milk curds, is occasionally found in furniture and wood objects. It is more resistant to the effects of moisture than the hide and fish glues.

b. Vegetable glue

Vegetable glues (e.g., starch paste), although traditionally used for certain types of materials (e.g., paper) were seldom used in adhering wood to wood. However, they are occasionally found in historic wood objects and period furniture where paper labels or paper coverings are affixed to the wood surface. Other types of vegetable glues, like gums and resins produced by trees, are commonly found on ethnographic wooden objects but were seldom used as adhesives on Western furniture. As with the hide and fish glues, vegetable glues are sensitive to changes in relative humidity and are susceptible to biodeterioration.

c. Synthetic Resins

Since the 1940's synthetic resin adhesives have become increasingly common in the fabrication of furniture and wood objects. Generally, these adhesives set either through the evaporation of a solvent, which may in some instances be water, or a chemical reaction between a hardener and a resin. Since a number of sites and associated museum collections in the National Park Service date to the post World War II period, there are many objects in park collections with these adhesives.

Most synthetic resin adhesives form an extremely strong bond. In addition, they are durable and less sensitive to environmental conditions. These positive characteristics can be a disadvantage if conservation treatment of an object fabricated with synthetic adhesives becomes necessary. Wood joints adhered with synthetic

resin adhesives are generally difficult, if not impossible, to disassemble without doing harm to the wood surface and the finish.

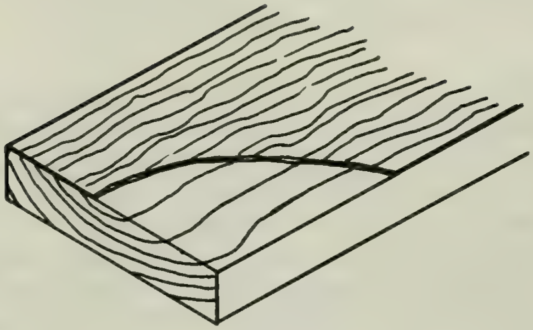
4. Veneer

A wood veneer is a thin layer of wood that is usually glued to a solid base material. The veneer is generally applied for aesthetic purposes. Exotic and expensive woods (e.g., rosewood and mahogany) were typically employed for veneering. Veneers with highly figured, wild grain coming from tree crotches and burls were prized. Marquetry, inlay and banding used numerous small pieces of veneer for various visual effects. Traditionally the veneer was applied over a solid wood substrate. In contemporary furniture making, the veneer often is applied over plywood or particle board.

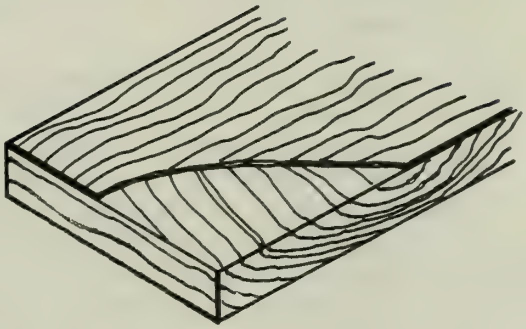
Veneers generally range in thickness from 1/32" to 1/8". The older veneers, which tended to be thicker, were sawn from the log with hand saws. They tend to be more irregular in thickness than the more recent veneers that usually are sliced off a log with mechanical knives. Veneers were traditionally glued to the underlying wood, usually called the secondary wood, with hide or fish glues.

Generally the grain of the veneer is oriented in the same direction as the grain of the underlying wood. However in marquetry, inlay and banding, the grain direction of the base wood has little bearing on the orientation of the veneer. There are also some areas in most types of furniture where the veneer grain must, of necessity, be oriented perpendicular to that of the base wood. This condition makes veneered objects particularly susceptible to damage from fluctuating relative humidity levels. Movement of the secondary wood can split the thin veneer if it is attached in anything other than a parallel grain alignment because wood shrinks and expands at different rates along different planes. Refer to Figure N.7 for common applications of veneer.

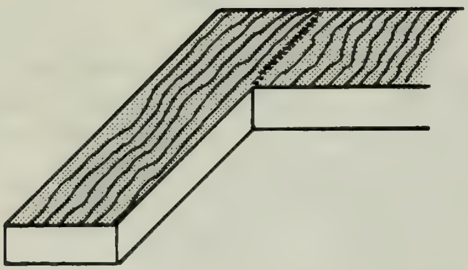
Some areas on veneered furniture are more likely to receive damage. Drawer rails and the bottom rails of case pieces (e.g., chests and side boards) are often veneered cross grain. As the secondary wood shrinks over time, a lip of veneer forms along the top and bottom edges. The movement of the drawer in and out can easily snag the protruding veneer and tear it off. Improper housekeeping procedures can also cause this type of damage. Dust cloths can snag the lip and pull off pieces. In addition, the veneer on the lower edge of bottom rails is often damaged by mop and broom handles and vacuum cleaners.



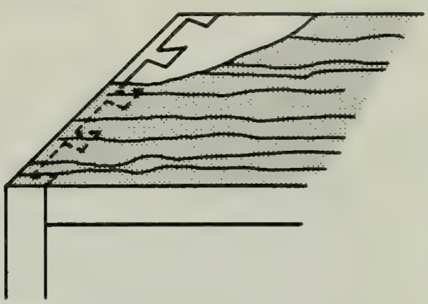
a. Veneer adhered in parallel grain orientation to secondary wood.



b. Veneer adhered cross grain to secondary wood. This type of application can result in splitting of the veneer in an environment of widely fluctuating R.H.



c. Veneer adhered over secondary joined with mortise and tenon. The joint line may telegraph through to the surface.



d. Veneer adhered over dovetailed secondary.

Figure N.7. Common Veneer Applications

5. Finishes

Furniture and wood objects usually are coated with either a transparent or a pigmented finish. The finish serves to visually enhance the object by bringing out the color and grain pattern of the wood and imparting a degree of gloss, to preserve the underlying wood by protecting it from spills and light damage, and to retard the movement of the wood by slowing down the transfer of water vapor to and from the surrounding environment. For some objects the finish is strictly utilitarian. For other objects the decorative aspect is of prime importance (e.g., the object itself serving as a support for the decoration).

Finishes that are applied to wood while in the liquid state are divided into two broad categories. One category consists of resins which are either dissolved or dispersed in solvent. They harden into the solid state as the solvent evaporates. Spirit varnishes fall into this category. The second category consists of those finishes which harden by means of polymerization and/or oxidation. Most oil finishes fall into this category. Some finishes, such as oil-resin varnishes, harden by a combination of both means.

The aging qualities of finishes vary. Some finishes, such as oriental lacquer, are sensitive to moisture and light damage. Others, such as shellac, are relatively resistant to light damage because they allow the light rays to pass through. This characteristic, however, subjects the underlying stain and pigmented heartwood extractives to a greater likelihood of fading due to light damage. Most modern synthetic resin varnishes are relatively hard and resistant to abrasion. Unfortunately, this quality often makes them more brittle.

Old finishes often have a distinctive appearance to which is ascribed the term patina. The meaning of this term is elusive, but it does have positive connotations to most people. Patina is often used to describe the warm tones of the oxidized wood, and the subdued luster of the finish together with the various waxes and oils which had been applied over time. There is a fine line between patina and damaged finish. What one person sees as patina another may see as damaged finish obscured by layers of gunk which in no way represents the original maker's intent. The argument over patina or damaged finish will not soon be resolved. However, it is important to distinguish any unstable finishes that are likely to deteriorate further because of adverse environmental conditions.

All finishes are damaged by exposure to high light levels. Light accelerates the rate of oxidation. As a finish oxidizes it becomes less flexible and therefore less able to expand and contract with the wood substrate in an environment of fluctuating relative humidity. Minute cracks in the finish film may result. This cracking, often referred to as alligatoring or crazing, may vary in form depending on the type of finish. Some light-damaged finishes may appear dull and chalky. Finishes which are flaking or where the edges of the islands of finish are lifting should be considered unstable. Normal housekeeping procedures, outlined in the Section E of this appendix, should not be undertaken on objects displaying this deterioration. If in doubt about the stability of a particular finish, request that a conservator examine it before any housekeeping procedures are undertaken.

Fluctuating relative humidity and the resulting expansion and contraction of wood can cause the condition of finishes, particularly those that are embrittled because of exposure to high light levels, to worsen. High levels of relative humidity can cause a finish to

develop a white opaque surface or bloom. Mildew can also damage finishes in an atmosphere of high relative humidity.

Stains and dyes often are applied to wood surfaces prior to the application of transparent finishes to impart a color to the wood. They penetrate the surface of the wood and color it, but do not form a film on the surface. There are a number of types of stains and dyes. The most common are alcohol, oil, and water-based. They vary considerably in their light fastness, depending on both the coloring material and the medium. Most traditional water-and alcohol-based stains are particularly sensitive to light damage. If it is known that alcohol or water stains were used in the original finishing or in the repair of an object, special precautions should be taken to limit its exposure to light.

Some of the more common types of finishes are wax, oil, varnish, shellac, paint, and gilt.

a. Wax

Waxes traditionally have been used both as a finish and as a polish or protective coating over other finishes. They are softer and more plastic than other finishes. Although insoluble in water, they are readily soluble in most organic solvents.

There are few, if any, examples of objects with original wax finishes in park museum collections. If any object in the collection is thought to have a wax finish it should be examined and verified by a conservator. **The cleaning procedure recommended for clear finished objects does not apply to objects with a wax finish.**

b. Oil

Linseed oil and tung oil are commonly used oil finishes. Typically, oil finishes penetrate more deeply into the wood surface but do not provide as hard a surface layer as solvent release finishes. Most oil finishes are slow-drying. They continue to polymerize and oxidize over a long period. Some oil finishes, such as linseed oil, will darken over time as they react with oxygen.

If applied in moderation and rubbed out well, linseed oil can be an attractive and serviceable finish. However, much damage to period museum furniture collections has occurred because of the use of this oil, often in combination with turpentine and beeswax, in misguided housekeeping efforts. Until relatively recently, it was widely believed that periodic applications of linseed oil to furniture would "feed and revive" the wood. The oil was often applied in excess and not rubbed off. Over time, furniture treated with this material developed a dark, opaque, and puddled appearance. This is due primarily to the fact that linseed oil

remains tacky for a long period of time, attracts dust, and darkens as it oxidizes.

Unfortunately, it is extremely difficult to remove the oil accretions and still preserve the underlying finish. **Oils, such as linseed oil, should not be applied to finished wooden surfaces as part of regular housekeeping procedures.**

c. Varnish

Varnish, a somewhat confusing term, is generally accepted to mean a resin in solution or dispersion that, upon drying, forms a hard transparent film, imparting a luster to the underlying wood. There have been numerous varieties of resins used in different formulas and solvents to make varnishes. Each has its own particular characteristics. There is a general distinction made between spirit varnishes and oil-resin varnishes. Spirit varnishes dry by the evaporation of volatile solvents (e.g., alcohol). Oil-resin varnishes dry by the oxidation and polymerization of the oil component, as well as by the evaporation of the solvent.

d. Shellac

Shellac, which consists of a resinous secretion of an insect, is the most common finish found on furniture in park museum collections. There are a number of finishes similar to shellac which consist of the same resin and differ primarily in the degree to which they are refined. In its various forms, it was the most popular finish in the 19th and early part of the 20th centuries. It was used as an original finish and also in refinishing and touching up of existing finishes. Pigments and other coloring agents commonly were added to shellac when it was used to touch up existing finishes. Shellac and similar spirit varnishes are more susceptible to damage from contact with water and alcohol than are the oil-resin varnishes.

e. Paint

Paints consist of pigment particles in suspension in a binding medium and a solvent. When the solvent evaporates, the film of the binder and pigment remains. Most varieties of paints used on furniture and wooden objects are relatively stable over time and are not easily resoluble. However, paints such as kalsomine or distemper also were used during the eighteenth and nineteenth centuries. These paints were made with a protein glue binder and are therefore easily resoluble with water. <u>Housekeeping procedures employed on surfaces of this type should be limited to dusting</u>. If there is any question of whether an object is coated with Kalsomine or distemper paint, consult with a conservator.

Much period furniture was originally painted with the intention that the character of the underlying wood would not show. It has been common practice in the 20th Century to remove original paint on furniture so as to reveal the wood. In recent years, an appreciation of the significance of original painted surfaces has developed.

f. Gilt

Gilt is found as a decorative accent on furniture and as a finish over the entire surface of an object. It is commonly found as a finish on ornate period picture frames. Generally applied over a wood base, a gilt finish consists of a gesso layer, a sizing layer and the leaf itself that is metal-hammered into extremely thin sheets. Both silver and various grades of gold leaf are used in gilt finishes. The stability of the finish will depend to a degree on the stability of the metal. Silver and the less pure grades of gold will oxidize. A barrier coating was sometimes applied to the leaf to provide protection and to color it. Pigmented shellac was often used for this purpose.

Gilt finishes are fragile. They are extremely susceptible to damage from rough handling and improper housekeeping. Avoid touching a gilt surface with bare hands because skin oils can accelerate oxidation. The gesso layer is usually brittle and inflexible. Movement of the underlying wood in response to changing relative humidity will often result in the cracking of the gesso layer. This condition telegraphs through to the metal leaf. Gesso will absorb water vapor in an environment with high relative humidity and will soften and expand. In extreme cases it will spall off the wood base.

Because of the inherent fragility and sensitivity of this type of finish, the type of curatorial care appropriate to it is different from that of other wood finishes. Establishing a stable environment is of paramount importance. Housekeeping should be limited to occasional removal of accumulated dust with a soft bristled brush and a low power vacuum. The vacuum nozzle should be held approximately 1/2 inch above the gilt surface as the dust is gently brushed out of the nooks and crannies with the brush.

6. Hardware

Drawer pulls, knobs, escutcheons, locks and other types of hardware are typically made out of brass on the more decorative objects and ferrous metal on the more functional objects. Brass, an alloy of copper and zinc, will become dull and darken as it oxidizes. Many pieces of furniture in park museum collections exhibit considerable damage on both hardware and surrounding wood surfaces. This damage has occurred as the result of housekeeping procedures intended to brighten brass surfaces.

In the most extreme examples, the brass is rubbed with abrasive sheets (e.g., sandpaper or emery cloth) and the hardware and surrounding wood surface is scarred by scratches. More commonly, the brass is damaged by frequent cleaning and polishing. Most polishes consist of abrasive powders, such as pumice or tripoli, in a liquid vehicle. If repeatedly applied, these polishes will wear away the surface of the brass. Typically, some of the powder will remain in the crevices of the hardware, and will show up as white accretions as the liquid vehicle evaporates. If the hardware is not removed during the polishing procedure, the wood finish around and beneath the hardware is likely to be damaged or even abraded away entirely. The green residue often found in crevices of brass hardware, is usually the result of using a cleaning or polishing agent which contains ammonia. If the hardware is not rinsed thoroughly after cleaning the ammonia residue, it will continue to react chemically with the brass.

Be alert to the possibility of original coatings on hardware, before cleaning or polishing them. Pigmented shellac often was applied to brass to help protect it and to give it a more golden tone. Occasionally the brasses on high-styled pieces were given a thin coating of gold in a process called fire gilding. This gold layer, if left intact, will keep the brasses from oxidizing, but it is easily damaged by the abrasives in polishes. If there is any evidence that brasses were originally fire-gilded, do not undertake any cleaning or polishing without first seeking advice from a conservator.

7. Upholstery

Upholstered furniture is susceptible to deterioration from both the agents that attack wood and those that attack textiles. Refer to Appendix K for a discussion of the agents that cause deterioration of textiles. Protein-and cellulose-eating insects are enemies of upholstered furniture. High relative humidity levels can lead to fungal attack that can do extensive damage to silk and woolen fibers. Mildew is most likely to start growing on fabric if it is soiled. It is therefore important to keep upholstered surfaces clean. Most fabrics are extremely sensitive to light that can fade colors and embrittle and weaken fibers.

In many furnished historic structures, upholstered furniture is displayed with the back close to windows. As a result, damage on the rear surfaces of upholstered pieces may occur from both moisture and light. This damage is often greater than that from wear found on the seat and back.

When in use, the fabric of an upholstered piece will normally have a shorter life expectancy than the underlying wood frame. A typical upholstered piece in a museum collection may have been re-covered a number of times during its period of use. The current upholstery fabric may not be appropriate for the period of interpretation. The traditional means of applying upholstery is to nail it to a tacking

ledge on the frame. If the object has been repeatedly reupholstered, chances are that the wood frame has been damaged by the tacks driven into it. Therefore, if a piece in a museum collection requires reupholstery due to the condition of the existing upholstery layer, the possibility of using non-destructive reupholstery techniques should be investigated. There are a number of non-destructive techniques used to attach upholstery fabric and stuffings to the wood framework. This is an instance where the object's visual information is preserved, but its function is not.

E. PREVENTIVE CONSERVATION

The primary areas of concern in the preventive conservation of wooden objects are: (1) providing a proper environment and (2) practicing good housekeeping procedures. Because wooden objects, in particular furniture, are exhibited often in furnished historic structures, the potential for damage from the environment and from improper housekeeping and handling is generally greater than for objects displayed in closed exhibit cases. Because of these factors, proper housekeeping procedures take on an added importance.

1. Environment

a. Relative Humidity

The ideal relative humidity level for wooden objects in most areas of the country is 50% plus or minus 5%. In drier climates, like that of the Southwest 35% to 40% is appropriate. Below 30% there is increased chance of glue failure from desiccation, loosening of joints, embrittlement of finishes, and excessive shrinking of wood tissue. In moist coastal zones 55% to 60% is acceptable. Above 70%, there is a greater chance of mold growth, insect infestation, glue failure, blooming of finishes, corrosion of associated hardware and excessive swelling of wood fibers. The key to ensuring the preservation of wooden objects is to avoid rapid fluctuation of relative humidity levels.

A change in relative humidity from 30% to 70% can result in an expansion of as much as 2% across the grain. This means that the side panel 24 inches wide on a piece of furniture could expand by almost 1/2". This kind of change may be sustainable without damage if it takes place over a relatively long period of time (e.g., seasonally). If the change occurs rapidly, damage such as splitting, veneer loss, and joint failure is likely to occur.

For this reason, avoid temporarily heating, air conditioning, or humidifying spaces that house wood objects and, thus, radically changing the ambient relative humidity. Avoid turning off heating and air conditioning units at night or operating them only at times of high visitation.

Exhibit wood objects in well-gasketed cases to reduce damage by fluctuations in relative humidity. The exhibit case itself acts to create a more favorable microclimate by slowing down fluctuations in temperature and relative humidity.

b. Temperature

The temperature of the environment in which wooden artifacts are housed is critical primarily in so far as it affects relative humidity. For this reason, consider installing a

humidistat to override the thermostat in the environmental controls of spaces housing humidity sensitive objects.

Changes in temperature also will cause some expansion and contraction of wood, but the expansion is very small and not considered to be a major threat to the object. In general, elevated temperatures will speed biological and chemical action. Avoid high temperatures in the environment housing wood objects to prevent an increased rate of oxidation of wood, finishes and associated metal hardware and an increased rate of fungal and insect activity. High temperatures associated with high relative humidity levels can cause some old finishes to become tacky.

Maintain temperatures at the lowest comfort level. For museum storage spaces, human comfort should not be a factor and temperatures can be further lowered. The temperature should not be allowed to reach or fall below the point of freezing.

c. Light

Light will change the natural color of heartwood, making light woods darker and dark woods lighter, fade stains, and embrittle finishes. It also will fade and embrittle fabric and leather on upholstered furniture. Limit the exposure of wood objects to both natural and artificial light sources to preserve the visual character of the object. The light level for most finished wood objects generally should not exceed 200 lux. The level for unfinished wooden objects should not exceed 300 lux. Some wooden objects, such as those decorated with fugitive stains and dyes, and furniture upholstered with light sensitive fabrics, such as silk, are more prone to light damage and the allowable light level should be adjusted down.

Light levels in exhibit and storage spaces can be controlled relatively easily when the major light source is from electrical fixtures. It is considerably more difficult to control light levels in furnished historic structures where natural light is often the primary source. A further complicating factor is that the historically accurate arrangement of furniture in a period setting may subject it to excessive sunlight levels.

Where possible, install UV filters on windows and florescent lamps to reduce most of the harmful UV radiation. This technique does not lower the level of visible light available to view the object. Therefore, steps may have to be taken to control visible light levels as well.

For most historic structures, install UV filters on all exterior windows. Equally important is to limit the amount of visible light entering the structure by utilizing historically accurate light limiting devices such as blinds, shutters, curtains and roller shades. These devices were found historically in many

structures. The recognition of the damaging effect of light on materials is certainly not a recent development. Although the interior may initially appear dim, the visitor's eyes will quickly adjust to the lower level. Additionally, the visitor will receive a more accurate picture of the light levels within an historic interior.

Another traditional technique for limiting light damage to upholstered furniture is the use of slip covers. There is photographic and written evidence to suggest that slipcovers were commonly used historically to protect upholstered furniture from fading and wear. Reproduction slipcovers can be used periodically in the museum setting for the same reasons.

d. Ambient Air Quality

Most modern museum structures incorporate a variety of filters in their HVAC systems to clean the air and filter out dust and other particulates. Objects displayed in these buildings also are protected by the exhibit case enclosure, some of which have their own filtering devices. Typically the dust will settle on a plastic or glass sheet rather than the surface of the object itself. Dust is an abrasive--it can scratch surfaces.It also serves as a source of food for mold and can make insect infestation more likely.

Furnished historic structures seldom have sophisticated air filtering systems and the objects housed in them generally are not protected by cases. In addition, because of the nature of the building more particulates are generated than in a modern building. These factors make frequent and proper housekeeping critical for the preservation of collections in historic structures.

2. <u>Storage</u>

Providing a protective environment for furniture and wooden objects while they are in storage is considerably easier than while they are on exhibit. Two requirements for exhibits that can work to the detriment of the objects--comfortable temperature and light--are not needed in a storage space. However, there are some other requirements for the proper storage of furniture and wood objects.

A great deal of furniture in a collection is heavy and bulky. Therefore, furniture storage spaces should be easily accessible. Narrow stairwells and doors should not restrict access. Slotted metal angle storage systems (e.g., Dexion®) are adaptable for the storage of furniture. Place large objects on the lowest level of shelving to avoid the potential of damage during lifting and movement.

Never store wooden furniture directly on concrete, stone or brick floors. Moisture can be wicked up through the masonry floor into the end grain of the feet of the furniture, causing fungal damage and staining. If the furniture is not placed on a shelving system, block it up, away from direct contact with the floor. It is a good idea to block up furniture even on non-masonry floors to prevent inadvertent damage to legs and feet.

If furniture and wood objects stored on Dexion® type shelving units are moved often for study or periodic exhibit, pad the edges of the metal members to lessen the potential for accidental abrasion.

Store wood frames on stationary or moveable racks, like those used to store framed paintings.

To the extent possible, store similarly sized wood objects together for space efficiency. This approach will minimize the likelihood of damage from moving objects around in the storage space.

Stacking pieces of furniture on top of one another is not recommended. However, if it becomes necessary due to space limitations, first inspect the structural stability of the lower object. Then place a protective layer (e.g., a padded blanket or sheet of polyethelene foam) between the objects. Do not stack the objects more than two high. Do not stack objects on top of upholstered furniture under any circumstances. The potential for damaging the fabric and the support layers is too great.

It is preferable not to store objects in the drawers of period furniture. However, if the drawer space must be used on an interim basis, limit the weight and lubricate the bottom of drawer slides with paraffin wax. This technique lessens the friction during opening and closing and reduces wear.

3. <u>Housekeeping--The Human Factor</u>

Under ideal environmental conditions, little or no housekeeping is necessary for the preventive conservation of furniture and wooden objects. However, an ideal environment is seldom the case for museum objects on exhibit. The conditions in historic furnished structures require intensified housekeeping both in terms of the kinds of procedures and their frequency.

Housekeeping is conducted for both aesthetic and preservation reasons. It should be carried out on a regular schedule. The schedule is dependent on both environmental conditions and the nature of the object and the structure.

a. Handling

Refer to Chapter 6 for guidance on planning and procedures for handling museum objects. In handling most wooden objects and

furniture the risks associated with wearing gloves often outweigh the benefits. Wearing gloves increases the possibility of snagging wood splinters or veneer edges. It is more difficult to securely hold heavy furniture with gloves. The finish and the wax polish present on most furniture will prevent hand oils from staining the wood. Most hand or finger prints left on these surfaces can be easily buffed out.

Wear gloves when handling gilt finished objects or unfinished objects made from light colored wood, where staining may be a problem. It is generally preferable to wear gloves when handling upholstered furniture.

b. Removing Dust

Dust on the surface of wood objects causes abrasion and attracts moisture. Dust also can be visually disturbing. Remove dust periodically to prevent damage and to maintain the proper appearance of the surface. The frequency of dust removal will vary depending on the surrounding environment. Within exhibit cases, dusting may be necessary only on a yearly basis. In historic furnished structures it may be necessary to dust on a daily to weekly schedule. **Remember: the purpose of dusting is to remove the dust from the immediate environment rather than to move it into the surrounding air where it can resettle on the same surfaces.**

Vacuuming is often the most efficient way to remove dust from wood surfaces. Hold the vacuum brush attachment just above the wood surface. A soft bristled brush, such as a lens brush, can be used to sweep the dust out of crevices and toward the vacuum brush. This technique should be used for removing dust from unfinished wood surfaces where the dust particles can settle in the pores of the wood. It is also effective for dusting carved and intricately molded wood surfaces. It is important to keep the vacuum clean. A clogged or full bag will shoot dust out of the exhaust port. The small, battery operated vacuums manufactured primarily for cleaning electronic equipment are useful for removing dust from small, delicate wood objects. The suction is considerably weaker than that of conventional vacuums. The narrow nozzle allows access to nooks and crannies not possible with larger vacuums. Most of these units come with brush attachments.

A clean cotton cloth is recommended for dusting. The cloth should be turned frequently, presenting a clean surface to the object with each pass, so that the dust is not wiped on the object's surface, thereby abrading it. The cloths should be washed frequently. In environments with low relative humidity, the cloth and the dust can pick up a static charge and repel one another, making it difficult to remove the dust efficiently. To prevent this, the dust cloth can be sprayed with a moderate amount of light mineral oil in an aerosol form, such as Endust®. Do not use

scented (e.g., lemon) products. This oil enables the cloth to pick up significantly more dust and not scatter it about. Do not spray products like Endust® directly on the object. They should be used in moderation and only when necessary for efficient dust removal.

An alternative to the use of mineral oil on the dust cloth is to dampen the cloth with water. If this technique is used, one should be careful that dust is not pushed by the cloth into corners and crevices of the furniture and that no moisture is left on the surface. Wipe over the dusted area with a dry cloth. Refer to Conserve O Gram 7/8--Dusting Wood Objects (Revised 1990).

Do not use feather dusters on museum objects. They simply scatter the dust back into the air. Feather dusters cannot be cleaned. In addition, there is a possibility of broken feathers scratching the surface of objects.

Do not wipe surfaces with unstable finishes (e.g., flaking, lifting edges) or surfaces that have loose or lifting veneer or splintered corners and edges. In some instances they may be vacuumed with a low suction vacuum so long as the brush attachment does not touch the surface of the object.

Dust can be removed with compressed air from particularly fragile objects and from irregular surfaces that are difficult to dust or vacuum. The pressure should be limited to about 10 pounds. If an air compressor is not available, canisters used for cleaning microscopes and photographic equipment can be used. These canisters emit a controlled flow of clean air which can blow the dust out of hard to reach areas. Cleaning with compressed air should be done away from the exhibit area if possible.

Stable upholstery surfaces also should be periodically vacuumed to remove dust. Refer to Appendix K for guidance on this technique.

c. Cleaning

On a periodic basis furniture and wood objects require cleaning to remove oils and grime. Again the frequency of cleaning depends on the surrounding environment. Objects housed in appropriate storage and exhibit cases may not need cleaning for a ten year period. Objects in an open exhibit typically require cleaning about once every three years. In some unusual museum situations, for instance where objects can be touched by visitors, cleaning may have to be done as often as once a month.

Only furniture with a sound finish should be cleaned. Do not attempt to clean objects where there is danger of the finish flaking off or veneer being snagged. Cleaning can be accomplished

with mineral spirits, such as Stoddard• solvent or naphtha, or with water and a mild, neutral pH soap.

Generally, mineral spirits is more effective on greasy types of soils and hand oils. Most wood finishes are not resoluble in mineral spirits. However, to be on the safe side, test the finish with a cotton swab dipped in mineral spirits in an inconspicuous location on the object. If the finish does not get tacky and no finish comes off on the swab, begin careful cleaning with a cotton cloth dampened in mineral spirits.

Mineral spirits will dissolve and remove waxes. Therefore, finished surfaces should be rewaxed after cleaning. **Remember, some 18th century pieces were originally finished with wax and retain that finish.** If there is any question whether an object in the collection has an original wax finish consult with the Regional Curator and a conservator before proceeding to clean the object.

As with any petroleum distillate, use mineral spirits in a space with adequate ventilation. Wear vinyl gloves to prevent contact with skin. A clean cotton cloth should be wiped over the finished surface until no more soils and wax come off on the cloth. During this process, turn the cloth frequently. Use soft brushes on carved surfaces. Wipe the object down with a clean, dry cotton cloth after using mineral spirits.

Cleaning with soap and water can be effective for removing some types of grime, like smoke and soot residue, not easily removed with mineral spirits. Soaps such as Vulpex•, Ivory• and Orvus• can be used. Follow manufacture's recommendation for dilution in water. Never use detergents. They tend to leave a film on the surface.

Water can harm some wood finishes. Test a small inconspicuous area to determine if the cleaning solution will cause discoloration. The cloth should be well rung out. After the object is wiped with the cleaning solution, wipe the entire object again with a cloth dampened in clear water and then wipe with a dry cloth. Do not use water to clean a veneered or inlayed surface if its finish is lost or extremely thin. Even small amounts of water can cause veneer to swell.

d. Waxing

The application of wax to clear finishes is recommended for the following two reasons. Wax enhances the appearance of the surface by filling in voids and small depressions, thus creating a level surface from which light is uniformly reflected. More importantly, from a preservation perspective, wax helps protect the surface from the effects of abrasion caused by dust and from handling. It facilitates dusting. In addition, it slows the

penetration of water and water vapor into the wood, thus, helping to protect the object from dimensional stresses imposed by short term changes in relative humidity. Wax, in effect, provides a first line of defense for some furniture and wood objects.

Waxes are smooth textured substances which have a low melting point and are soluble in most organic solvents. When the solvent evaporates, the wax film is characteristically lustrous, slippery and plastic. Waxes are derived from animal, vegetable mineral and synthetic sources. The natural waxes, like beeswax, have been used for centuries as both a finish and as a protective film over other finishes. Individual waxes possess different characteristics. Most commercial paste wax products are mixtures of various waxes, combined to attain desirable characteristics like hardness, durability, ease of application, and evenness of luster.

There are two types of paste wax polishes: those made with water and those made with organic solvents. The waxes recommended for use on wood objects in museum collections are formulated with the weaker organic solvents (e.g., turpentine and mineral spirits). Avoid waxes formulated with the stronger solvents (e.g., xylene and toluene) because they can damage some finishes.

Apply only paste wax polishes to museum objects. Most liquid polishes and virtually all aerosol polishes contain silicones. <u>Avoid using any silicone containing materials</u> on wooden objects. These formulations do not afford the same protection as the paste waxes. In addition, the silicone migrates into the finish, complicating any future conservation treatment.

Apply paste wax polishes only to stable, clear finishes, such as shellac, varnish and modern lacquer. Do not apply paste waxes to objects that were not originally finished, because it will penetrate into the pore structure and impart a different appearance to the object than originally intended. Waxes applied to unfinished wood surfaces cannot be completely removed. When waxing a finish for the first time, test the wax in an inconspicuous location to determine if it disturbs the finish.

When waxing the wooden elements of upholstered furniture, take care that no wax contaminates the upholstery fabric. Sheets of Mylar® can be laid over the upholstered edge to help protect it during waxing. Be careful not to get wax into cracks or splits in the wood. This can make adhering of the crack difficult should the object be treated by a conservator at some future date.

The optimum frequency of waxing will depend on environmental factors (e.g., dust, relative humidity and light). Most wood objects in furnished historic structures will require rewaxing every one to four years. Objects in well gasketed exhibit cases may only require waxing at ten year intervals. **As a rule of thumb, rewaxing is not necessary as long as the existing wax layer**

can be buffed to a sheen. Under unusual circumstances where museum objects in the collection are used or touched, waxing may have to be done on a more frequent basis. The purpose in this situation is to have the wax surface rather than the finish or the underlying wood act as the wearing surface.

Clean the object to remove the existing wax before a new wax film is applied. Waxing over dirty surfaces will produce a grimy buildup and, in time, obscure the color and figure of the wood.

Always apply the wax sparingly. Too much wax results in a sticky surface, that acts to attract dust and dirt. Apply wax with a clean, cotton cloth, first rubbing in a circular motion and then rubbing along the grain. After the solvent has evaporated, usually 1/2 to 1 hour, buff the wax out, again using a clean, cotton cloth. If the luster is uneven or if additional protection is required, repeat the procedure. <u>It is preferable to apply two thin coats rather than a single thick coat</u>.

On carved and irregular surfaces, apply the wax with a soft toothbrush and, then, buff it out with a soft fiber brush (e.g., a shoe brush). Tape foam padding to the wood ends of the brush to avoid the potential of damaging the object while buffing.

Applying wax in an environment with excessive heat or relative humidity can cause the wax film to cloud up or whiten. If this occurs, remove the wax with mineral spirits. Rewax the object once the environmental problems have been corrected.

Light-colored waxes will sometimes leave whitish specks in the wood pores and in recesses of carving on dark wood. This condition will not show up until the solvent has evaporated completely, which may not be for some time after the object has been waxed. These specks can be removed with a wood pick. An acceptable alternative is to use a pigmented wax on dark wood.

There are a number of good paste waxes on the market, including Staples®, Butchers®, Johnson® and Trewax®. Renaissance Wax®, a product commonly recommended for use on museum objects, is a synthetic wax with no perfumes or pigments. It is durable and highly water resistant. However, it can be difficult to buff to an even luster on large surfaces. It is more appropriate for use on smaller wood objects, particularly those which incorporate other types of materials (e.g., metals).

e. Care of Associated Hardware

The best method for attaining the appropriate period appearance on hardware while preserving the material is to clean and polish it once and then apply a sprayed lacquer film with corrosion inhibitors. This treatment, if properly done, can last as long as twenty years. The treatment requires specialized equipment and

experience and generally should be carried out by a conservator. Refer to Appendix O for guidance on cleaning, polishing, and coating metal objects.

If conservation treatment on the object is not feasible, limited on-site treatment can be performed on the hardware. It is preferable to remove the hardware from the object if it can be accomplished without damage. Once removed, tag the hardware to document its original location on the object. Clean the hardware with a solvent (e.g., mineral spirits or, if a more powerful solvent is required, acetone). After cleaning the hardware, polish with a slurry of whiting in mineral spirits or with a commercially available mild abrasive polish that <u>does</u> <u>not</u> contain ammonia. Degrease with a solvent and wash with distilled water. <u>Note: All polish residue must be removed</u>. An assortment of brushes most effectively remove it from crevices. Remember any polishing removes original material from the object. If it is done at all, carry out polishing gently and infrequently.

After cleaning and polishing, wax the hardware. Although not as effective a barrier as lacquer, the wax will retard oxidation. Apply the wax to all surfaces of the hardware including the rear surface and buff out well. Microcrystalline waxes, such as Renaissance Wax®, are recommended for this application.

If removal of the hardware from the object is not possible without causing damage, the above treatment can be accomplished in place by inserting Mylar® sheets behind the hardware, cutting out slits so they can slip by the bolts or bails. Cleaning and polishing in place must be executed with extreme caution so that solvents, water and polishing compounds do not contaminate the surrounding wood finish. If there is any doubt about the ability to polish the hardware without causing damage to the object, wait for treatment by a conservator.

4. <u>Preventive Conservation- Occasional Tasks</u>

a. Moving

Furniture is particularly prone to damage while it is being moved. Furniture is often large, bulky and heavy, making it more difficult to move safely than most museum objects. In addition, furniture typically has doors, drawers and other appendages which, if not properly secured, have a tendency to fly open or fall off during a move. Due to its substantial weight, the nature of wood, and the type of joinery, some furniture can be easily damaged in moving if it is not grasped and supported properly.

The most important factor in ensuring a safe move is careful planning. Nothing has greater potential for damage than to get an object half way up a flight of stairs only to discover it will not go the rest of the way. To eliminate any doubt, measure the

object to ensure that it will safely pass through all doorways and other potential obstructions in the planned route.

Obtain enough help to safely execute the move. Park staff should not have to strain under the weight when moving museum objects. Ideally one individual, who is not actually carrying the object, should coordinate and guide the moving of large furniture. If large, heavy objects are to be moved a distance over flat surfaces, it is preferable to use mover's dollies.

Never slide furniture across the floor. Sliding places a great deal of cross grain strain on feet and legs and can result in fracturing of the wood or loosening of the joinery between base and feet.

Carefully consider where to grasp and support furniture while lifting and moving. Picking up objects in the wrong location can cause substantial damage. Never use original handles and straps to lift trunks and chests. Lift trunks and chests from the bottom. Do not lift tables and case pieces (e.g., chests of drawers) by the protruding edges of their top boards. This practice can result in splitting of the boards and weakening or total failure of the fastening between the object's top and base. Lift these types of objects by their lowest horizontal structural member. Lift a table by its apron and a case piece by its bottom rail.

Chairs can be easily damaged if they are lifted by the crest rail--a temptation since this is the portion of the chair within closest reach. The safest way to pick up a chair is to bend at the knees and grasp its side seat rails. Note if a chair has an upholstered slip seat. Since slip seats are often held in place with a friction fit, they can be easily dislodged and damaged in the course of a move. Refer to Figure N.8 for illustrations on proper techniques for moving furniture.

Upholstered sofas are particularly difficult to move safely and often are damaged during the attempt. They are heavy and bulky and their width is often difficult to gauge because the seat backs commonly are angled out. The simplest way of measuring the width is to place it against a wall, put a rule or tape on the floor, one end against the same wall and sight down from the middle of the seat rail, usually the widest part of the sofa.

Do not lift a sofa by its arms. The joinery between the arm and the frame is not designed to withstand the strain and can be easily damaged. This is particularly true of rolled arms which are angled out from the seat frame. Lift sofas by the bottom rail. Large sofas and those with rolled arms are most safely moved by four people, one at each corner.

Figure N.8. Proper Techniques for Moving Furniture

Before moving a piece of furniture, examine it for any structural instability, such as broken or loose joints or splits which may not withstand the stress of moving. Secure or remove doors, drawers and other furniture elements, such as pediments and galleries, prior to moving. Where weight is a factor, the best option is usually to remove all elements which are easily removed. Always remove marble tops prior to moving. Move and store them on edge. They can fracture from their own weight if held horizontally and supported only at the ends.

Secure doors, drawers and drop lids with cloth tape. This technique is preferable to using twine or rope that has a smaller and rougher bearing surface and can abrade or cut into the object.

Never use adhesive backed tape to secure doors, drawers or lids. It can leave an adhesive residue and lift the finish when removed. Even tapes that can be removed without damage when fresh, like masking tape, can become intractable after a short period of time.

b. Loose Pieces

Pieces may come loose from furniture and wooden objects for a variety of reasons: glue failure, structural failure, accidents during moving, and cleaning. If pieces become detached, place them in a closable polyethylene bag with a label that documents the date, the location from which the piece came, and the catalog number of the object. If possible, keep the bag with the object.

Do not tack loose pieces back into place. Under most circumstances it is preferable to wait for conservation treatment rather than attempt a glued repair. If there is an urgent need to execute a repair, consult the Regional Curator and a conservator for guidance. Only a reversible glue (e.g., hide glue) should be used.

If more than one piece becomes detached from an object, it usually indicates a problem in the environment or in the housekeeping procedures. It may indicate that the object is too unstable to undergo dusting and cleaning, in which case it should be taken off exhibit to await conservation treatment.

c. Removing Mold

The presence of mold is indicated by smell as well as the appearance of mildew, a white fluffy substance growing on the surface of wood and upholstery. The growth of mold depends on the environmental factors: high relative humidity, lack of air movement, and little or no light.

To remove mold, lower the relative humidity level and increase the air circulation. If possible, remove the infested objects from the rest of the collection and temporarily place them outside where the light levels and air circulation presumably will be stronger and where they will not infect the rest of the collection. Brush or vacuum the mildew off of the object. If vacuumed, discard the bag when the procedure has been completed. The mold then can be wiped off with a solvent dampened cloth. Use a 50% mixture of alcohol and water on unfinished surfaces and on finishes other than shellac. Test a small inconspicuous area before proceeding. If a shellac finish is suspected, wipe the surface with a cloth dampened with mineral spirits. Dispose of cloths used to remove mold.

d. Insect Infestation

Wood boring beetles, the most common museum insect pests which attack wooden objects, create flight holes on the surfaces of objects as they exit. The presence of these flight holes is an indication that the object has been infested by beetles. However, it does not necessarily indicate an active infestation. The wood from which the object was made may have been infested while in the tree or while being seasoned. The object may have been infested while it was relatively new. The starch content in the wood of new objects is higher and, therefore, more attractive to most wood-boring beetles. Refer to Chapter 5 for guidance on biological infestations.

There are a number of factors which help determine if the infestation is current. The presence of frass, a light-colored powder produced by the larva as it consumes cellulose, is one such indication. If frass is found on the floor in the vicinity of wood objects or on the lower horizontal members of wood objects, immediately begin monitoring the object. Isolate the object from the rest of the collection. Place the object on a dark paper or cloth surface and wrap with polyethylene sheeting. Frass can sift out of the channels from inactive infestations if the object is jarred during a move or during housekeeping procedures. If an active infestation is suspected, be careful not to jar the object, while it is wrapped and isolated. If new frass then appears on the dark surface it can be assumed that the infestation is active.

Another means of determining whether an infestation is current is to shine a raking light across the wood surface. If the exit holes are dark from soils and oxidation or if there are remnants of finish in the exit holes, the infestation has taken place in the past. If the exit holes are light and the edges sharp, in all probability the infestation is active.

Some species of wood boring beetles can actually be heard as they consume the wood. The presence of a low level munching sound coming from a wooden object is a certain indication that there is an active infestation.

Wood-boring beetles generally make their exit holes in the spring and instinctively fly out to light. Therefore, the presence of adult beetle carcasses on window ledges in the first warm months is a good indication of infestation in the building or in the collection.

F. WOODEN OBJECTS CONSERVATION ISSUES

The preservation of furniture and wooden objects is a responsibility shared by curator and conservator. Because of the nature of wooden objects and the fact that they often are exhibited in open spaces, the curator is often asked to provide more hands-on housekeeping than is customary with other types of objects, such as paintings and paper. It is, however, important for the curator to know how far to go in hands-on work and when to call the conservator for advice and treatment. For this reason the curator should be able to discern when a wooden object is in less than perfect, but stable condition, as opposed to unstable condition.

1. Assessing Stability

Most furniture and wooden objects in park museum collections show evidence of use and damage. This condition may or may not be appropriate for the interpretation of a particular object, depending on the type of object and the exhibit context. A damaged condition may be, but is not necessarily, unstable. It should be considered unstable when further deterioration is likely to result if the condition is not corrected.

In some situations the existing damage may be so extensive that the object is not subject to further damage. For example, a grain-painted chest may have lost all original finish before it was acquired for the museum collection. The object's condition is stable and, unless it is determined from a curatorial standpoint that repainting the decorative finish is appropriate, conservation treatment is not warranted. There may be a similar chest with a decorative paint layer remaining that is crazed, and has lifting edges. In this case, the finish is unstable. The historic appearance and material can be saved. This object, if significant from a curatorial standpoint, warrants conservation treatment.

a. Structural Stability

To assess structural stability, examine the object, considering the following factors: glue failure, mechanical joint failure, missing and loose elements, and cracks and splits.

Generally glue failure and breaking or loosening of joints will cause structural instability. Loose joints and lifting veneer usually indicate environmental problems which have caused the glue to redissolve or become desiccated. Conservation treatment is usually needed to stabilize objects with this kind of damage. However, it should be emphasized that conservation treatment ultimately does little good if the objects are returned to an environment in which the adverse conditions have not been corrected.

Missing elements may cause structural instability depending upon location. A lost finial on a tall case clock will not cause

further damage, while a lost foot on the same clock may result in disaster.

Cracks and splits may cause structural instability. If the split occurs in a structural member that must support the weight of the object, it should be treated. Additionally, if movement is possible on either side of the split, the object should be treated.

Some types of fungal activity can result in structural instability. The presence of decay fungi should be distinguished from the presence of mold and mildew. Mold and mildew cause only surface disfigurement to wood. It can be removed on site using the steps previously outlined. <u>It will do significant damage to textiles and paper associated with wooden objects</u>. Consult a conservator if these materials are affected.

Decay fungi consume cellulose and lignin. If left unchecked, decay fungi will cause severe deterioration of wooden objects. The deterioration can be halted by changing the environmental conditions, but its presence usually leaves the object in an unstable state. The presence of decay fungi can be detected by the presence of cracking along and across the grain, a dead sound when struck, loss of weight, a friable surface, and its characteristic odor. Because the decay usually occurs at the base or feet of an object, where it contacts the floor, objects affected by decay fungi are often left unable to support their own weight. Wood damaged by decay fungi can be consolidated during conservation treatment and a degree of structural stability restored if the decay has not progressed too far.

The channeling done during an insect infestation can cause structural instability if it is extensive. The exit holes on the surface will, in any event, cause visual disfigurement. The presence of numerous exit holes on the surface of an object indicates the need for a thorough structural examination and possible conservation treatment.

b. Stability of Finish

The presence of crazing or drying cracks on a finish does not necessarily indicate the finish is unstable and in need of conservation treatment. As finishes oxidize, they become more brittle and consequently less able to move with the underlying wood, resulting in cracking. If they maintain a good bond to the substrate, conservation treatment is probably not needed. However. if the islands of finish created by the crazing are lifting or discoloring along the edges or if the finish is exfoliating, conservation treatment is warranted.

c. Stability of Hardware

Dull, oxidized hardware on furniture and wooden objects is not necessarily cause for immediate conservation treatment, nor is the inappropriate appearance. Each case should be considered separately to determine what treatment is necessary. This situation should be distinguished from one in which there is active corrosion, which if not stopped will deteriorate the metal and, under some circumstances, stain the underlying wood.

On ferrous hardware, a coating of red or red-orange rust that will show up on a white cotton cloth rubbed over the metal is indicative of active corrosion and should be corrected by conservator treatment. The presence of a green corrosion product or white polish residue on brass and copper hardware is also an indication of a condition that should be corrected by conservation treatment.

2. Documenting Condition

The condition of furniture and wooden objects in museum collections should be periodically documented. Documentation can be both written and visual. Measured drawings, sketches and photographs are useful.

Note the occurrence of obvious damage, such as loss of veneer or scratches from cleaning equipment. It is also important to note deterioration which takes place over a longer time frame and is not so dramatic, such as progressive crazing or fading of finishes. Photographs taken at regular intervals and dated are useful for this purpose.

If a split is noted, periodically record its length and width. If it enlarges over time, consult a conservator about treatment.

Periodic documentation of condition allows correlation with records from environmental monitoring. For example, this method provides baseline data to determine if seasonal variations in relative humidity affect the width of a split in an object.

3. Communicating with the Wooden Objects Conservator

It can be difficult to describe the particulars of an object's condition over the phone or by mail. Familiarity with some of the typical problems associated with wooden objects and the causes of those problems can facilitate communications between the park's curatorial staff and the conservator.

Communication with a conservator also can be facilitated if proper terminology in regard to the anatomy of objects is used. Section G of this appendix lists references that address the names of parts of furniture. There is no universal agreement among curators, conservators and connoisseurs on the correct terminology for parts of

furniture. But using widely accepted terms will at least facilitate communication.

Photographs, drawings and sketches that illustrate condition are extremely useful. Video tapes, although not necessary to illustrate most objects, can be of great help in showing the condition of large, complex, 3-dimensional objects.

Catalog information, previous treatment reports and any documentation of the object's past condition can help the conservator in assessing the problem and determining a course of treatment.

4. Conservation Treatment of Furniture and Wooden Objects

The following functions are among those typically performed by a conservator in the course of treating wooden objects and furniture. The appropriate treatment for each individual object is determined by condition and intended use.

a. Examination

As in other areas of conservation, the first step in treating an object is to examine it to determine condition and the causes of deterioration. The wooden objects conservator typically examines an object to determine structural stability and finish stability, as well as evidence of insect and fungal decay. The conservator often attempts to identify the type of wood, finish, adhesive and joinery techniques used in the fabrication of the object. Microscopes and specialized photographic techniques are commonly used in the course of examination.

b. Cleaning

Cleaning is done by mechanical and chemical means to remove foreign soil buildup, stains and paint deposits, as well as non-original and post-period surface coatings. The extent of the cleaning will depend on the nature of the particular object undergoing treatment. Any cleaning which may remove important signs of use is to be avoided.

c. Structural Repairs

The main purpose of structural repairs is to restore structural integrity to the object. These repairs do not necessarily restore the appearance of the object. For example, a chest of drawers with lost or severely damaged feet may be returned to stability with a mechanical support rather than with the installation of reproduction feet. Alternative methods of restoring stability usually are employed if replicating original forms would have to be based on conjecture, or if use of original joinery and construction techniques would result in damage or removal of original fabric. To the extent possible, the conservator attempts

to make the repairs reversible so that, if necessary, they can be easily removed at some point in the future.

d. Replication of Missing Elements

The replication of lost areas or missing elements is not automatically undertaken in the course of treatment. The decision to replace missing elements is a collaborative one between the curator and the conservator. Among other factors, it will depend on the object's significance and the ability to replicate the form without relying on conjecture.

Replacement of lost areas or elements may be accomplished using in-kind materials and techniques or modern ones. For example, an area of lost mahogany veneer originally adhered with hide glue can be patched with the same wood species and the same adhesive type. Alternatively the area can be patched with a photographic reproduction of the inlay adhered to the substrate with a synthetic adhesive. The value of non-destructive reupholstery techniques is increasingly recognized in the conservation field. These techniques preserve or restore the appearance of the object, while at the same time protecting the integrity of the underlying frame.

The considerations for determining which materials and techniques to use in a particular situation include: degree of reversibility, need for visual conformity, minimization of damage to original fabric, time and cost.

All replacements should be documented in writing and photographically. Where possible, replacement elements should be labeled with the maker and the date.

Under most circumstances, the goal of the conservator is to make replacements unobtrusive to the museum visitor, but discernable to the curator.

e. Consolidation

Consolidation of wood is sometimes called for when the wood fiber has been damaged by fungal activity, insect attack or chemical action. Consolidation can be accomplished with the use of a number of natural and synthetic resins in a variety of solvents. The decision to use consolidants should be carefully considered because the result is never completely reversible and almost inevitably there is some visual change to the wood surface.

f. Treatment of Finishes

Under most circumstances, the conservator attempts to preserve the existing finish on furniture and wooden objects. This is always the case if the existing finish is original. For many objects the

existing finish may be old but not original. So long as the existing finish is not inappropriate, the attempt is made to preserve it.

Preservation may involve only cleaning and waxing. If the existing finish is unstable (e.g., lifting edges), preservation may involve the use of solvents to partially dissolve the finish film and lay it back down on the wood substrate. "Amalgamation" of crazed surfaces is possible on some finishes. Here the top layers of the finish are partially dissolved and a continuous finish film is re-formed.

Areas of finish and stain loss can be treated by toning in losses and infilling with finish. Reversible finishes are usually used in this process.

Occasionally refinishing is called for because the existing finish either is not appropriate or has been lost, perhaps entirely. If refinishing is required, the conservator attempts to use the least harmful means of finish removal and a new finish which is readily resoluble. Generally a small unobtrusive area is left intact to document the finish history of the object. The decision to refinish should be carefully considered by curator and conservator.

g. Application of a Surface Barrier

Surface barriers are often applied to help protect against moisture, dust, light and staining. Wax is the surface barrier commonly used on finished wood surfaces. Sheer fabric, such as Stabiltex® or Crepoline®, can be used to protect sensitive upholstery fabric. Stable unobtrusive sheet material, such as Mylar® or an acrylic can be used to protect wood surfaces from marring or abrasion.

G. EMERGENCY PROCEDURES FOR WOODEN OBJECTS

Most emergencies which affect museum objects involve water. The steps outlined below are those that should be taken by site personnel immediately after the emergency. Refer to Chapter 10 for guidance on emergency planning and to Chapter 8 for general rules on appropriate response to emergency situations involving museum objects. A conservator usually will be needed to ultimately address the preservation problems created by the disaster.

Moving furniture subjects it to potential damage. Furniture should be moved only if absolutely necessary. Some emergency situations (e.g., flooding from broken pipes) may not necessitate moving the entire collection from the affected space so long as the water can be removed quickly. If the collection must be moved, follow appropriate handling and moving techniques. Moving the collection because of the threat of fire is the exception.

Water damage usually affects the finish and causes wood to swell. If there is standing water on the floor for a period of time, the water and any salts that may be dissolved in it will be carried up through the end grain of the feet and legs of furniture. The salts may effluoresce on the surface of the legs creating "tide" lines. Floods and water damaged ceilings may deposit mud, plaster or gypsum on horizontal furniture surfaces. The high relative humidity levels present in spaces that have been flooded often will result in mold growth on objects. Upholstery fabric may stain and shrink. The oxidation of hardware, particularly ferrous hardware, will be accelerated.

In the event of an emergency involving water damage, implement, as appropriate, the following actions:

- Do not dry out wet wood objects too quickly. Remove all water from on and around the object as soon as possible. Lower the relative humidity level slowly to acceptable levels. It may be necessary to cover affected objects with a polyethylene tent to ensure slow drying.

- Remove drawers and open doors if possible, so as to even out the drying process on all surfaces. If drawers and doors stick due to swelling do not force them open.

- Block all objects up from the floor so that the water will not migrate up the feet and legs. This technique will facilitate drying of the bottom surfaces.

- Use fans to provide good ventilation and thus decrease the likelihood of mold growth. Do not aim the fans directly at the furniture.

- Remove ferrous hardware from the furniture so as to avoid staining. This is particularly important in the case of wood species that have a high acid level, like oak. Tag all hardware, furniture elements and loose pieces as they are removed.

- If upholstered furniture is fully soaked, remove the outer fabric, padding and support. There is a danger that saturated outer fabric left in place will split as it dries. The padding can be dried relatively quickly without damage. Feather cushions can be dried by placing them in a clothes drier at a low temperature setting. Clean and slowly dry the wood framework.

- If mud or plaster has been deposited on wood surfaces it can be sponged off with clean, cool water. The sponging action should be gentle. Avoid wiping the surface with a gritty sponge. Rinse the sponge often. Do not try to remove the deposits with a dry cloth because this action can result in abrading the surface. Wait for a conservator's assistance in the removal of mud and plaster from fragile and unstable finished surfaces, such as gold leaf.

H. SELECTED BIBLIOGRAPHY

Butler, Joseph
1985 Field guide to American Antique Furniture. New York: Roundtable Press

Hoadley, R. Bruce
1980 Understanding Wood, A craftsman's guide to wood technology. Newtown, CT: The Taunton Press.

Ketchum, William C. Jr.
1982 Chests, Cupboards, Desks and Other Pieces. New York: Knopf.

Levitan, Al and Jordan, Anne
January 1990 "Dusting Wood Objects," Conserve O Gram 7/8. Washington, D. C.: National Park Service, Curatorial Services Division.

McGiffin, Robert F. Jr.
1983 Furniture Care and Conservation. Nashville, TN: The American Association for State and Local History.

Mussey, Robert
Prevention of Damage to Furniture, Audio visual Instructional Program

A two part slide tape program dealing with agents of deterioration and proper housekeeping and handling procedures for furniture in furnished historic structures. Many excellent slides which illustrate effects of improper housekeeping and environment on wood, fabric, hardware and finishes.

Penn, T. Z.
1984 "Decorative and Protective Finishes 1750-1850", APT Bulletin, Vol. XVI:1:3-45. Association of Preservation Technology.

Schwartz, Marvin D.
1982 Chairs, Tables, Sofas and Beds. New York: Knopf.

Sandwith, Hermoine and Stainton, Sheila
1984 The National Trust Manual of Housekeeping, Chapter 6 - "Furniture", 80-93. London: Allen Lane, Penquin Books Ltd.

U.S. Department of Agriculture, Forest Products Laboratory
1974 Wood Handbook: Wood as an Engineering Material. Washington, DC: Superintendent of Documents, U.S. Government Printing Office. U.S. Forest Service Handbook No. 72.

APPENDIX O. CURATORIAL CARE OF METAL OBJECTS

APPENDIX O. CURATORIAL CARE OF METAL OBJECTS

A. INTRODUCTION

Metallic elements comprise the largest proportion of the materials that make up our planet. However, metal, when used to form decorative and functional objects is the exception in nature. The basic ores from which metals are obtained do not exhibit metallic properties in their natural state. Refinement of metal ores requires the application of much energy, usually in the form of heat or electricity. The resulting metals are prized for their luster, strength, thermal and electrical properties. Unless well maintained, most metals readily revert to a corroded state. In order to maintain metals in the park's museum collection, it is important to understand the basic properties of metals.

Metals have been an important factor in technological and economic development, so much so, that two important historic eras are identified as The Bronze Age and The Iron Age. Throughout history, man has explored the seemingly endless properties of metal; putting it to work, putting it to war, using it to embellish and decorate architecture, and for the creation of works of art that are valued for aesthetic reasons. The preferred medium for the commemoration of important figures and events in history is frequently metal. The technology of metals has evolved to answer many different requirements and has provided the means by which many dreams could become reality, such as modern aircraft transportation and trips to the moon and beyond. The industrial, and the technical applications of metal and metallic properties continue to be strong.

Metals are frequently selected for applications in architecture, decorative arts, fine arts and functional objects. Functional objects are those utilitarian machines and devices designed to perform some special task, such as a steam engine, a sewing machine, an automobile, or an aircraft. The number of functional objects within the National Park Service is growing because of the addition of new parks with the mission to preserve and interpret sites of industrial or technological development. The functional object is problematic because of its large size and complexity. Usually these objects require a high degree of maintenance.

The physical properties of metal include <u>luster</u>, <u>hardness</u>, <u>strength</u>, <u>malleability</u>, and <u>temperature sensitivity</u>. Different metals and alloys exhibit differing physical properties. Cast iron has good compressive strength but poor tensile strength, while wrought iron has good tensile strength. Historically, these various properties have been exploited in the construction and fabrication of metal structures and objects. An example is the bimetallic temperature sensor used in recording hygrothermographs. Within the historic furnished house structure, a cold metal surface may be the site for condensation that may result in corrosion, water damage to surrounding surfaces, or rust staining. Awareness of these properties is important to the maintenance of metal objects.

This appendix focuses on the basic properties, typical methods of manufacture, and finishing techniques of metals encountered in National Park Service museum collections. It addresses preventive conservation procedures and techniques and discusses metal conservation issues. This appendix does not address metals recovered from an archeological context. Care of archaeological metals is discussed in Appendix I.

B. THE NATURE OF METALS

1. Types of Metals

Elemental metals are characterized as those elements which are electropositive. Among those elements found in museum objects are gold, silver, copper, tin, iron, lead, zinc, nickel and aluminum. Metal elements are frequently combined in order to modify their properties or to obtain a metal which is most suitable to a given application. The process of combining two or more metals is termed alloying. An alloy is created by melting one metal and then adding the other metals to it.

The alloy is a solid solution since the metal elements remain distinct, one suspended in the other. Examples of common alloys are brass (a mixture of copper and zinc), bronze (a mixture of copper and tin), and sterling silver (a mixture of silver and copper). By varying the proportions of copper and zinc in brass alloys it is possible to obtain a range of brass alloys with differing properties. It is therefore possible to alloy a brass which has the desired color, strength, corrosion resistance, or working properties.

Surface treatment is an important characteristic of the metal object. Frequently the surface is finished to enhance the appearance of the object, to improve the functional performance (e.g., corrosion resistance), or a combination of both. Surface treatments include plating, patination, coatings, heat treatments, and chemical treatments.

It is not unusual to discover examples in which the base metal of an object or a surface finish has been misidentified. The consequences of misidentification can be serious and may, in the more extreme cases, result in the loss of an important object. Proper identification is important to object accountability, housekeeping procedures, accurate interpretive program information, storage and exhibit techniques, and the conservation treatment process. In order to identify a metal object properly it is necessary to possess a basic knowledge of the properties of metals and to have some basic tools and supplies. Knowing what you don't know is equally important. It is much better to describe a metal as a white metal than to run the risk of misidentifying it as pewter, silver, or nickel.

2. The Metallic Bond

The properties of all matter are determined by their atomic structure. In an introduction to the nature of metals, a basic understanding of the nature of the metallic bond is important. For it is the electron distribution in metals that is responsible for metallic properties and for corrosion. Corrosion is an electro-chemical process.

The basic constituents of the atom are the proton, neutron, and the electron. The positive and negative forces of the proton and the electron are attracted to each other. The attractive force serves to hold the subatomic particles together. The simplest atomic configuration is ideally the hydrogen atom, consisting of one proton and one electron. The natural laws that govern atomic architecture are complex. Hydrogen is rarely found in such a simple configuration. Usually two atoms of hydrogen join together to form a molecule of hydrogen. It is very rare to find in nature, a material in which the forces of the subatomic particles are evenly matched. When it does occur, the material is extremely stable and will not normally interact with other surrounding materials. The "noble gases", such as helium, neon, and argon are examples of inert materials.

In the metallic bond, each metal atom is closely surrounded by many similar atoms, each with only a few electrons in its outer shell. In this situation, the electron clouds overlap and the loosely held outer electrons are so completely shared as to be no longer associated with individual atoms. Leaving the metal atoms in place as ions, they form an electron gas, a pervasive glue that moves freely among the ions and binds them together.

The electro-positive character of the metal ion results in the tendency to combine with electro-negative ions such oxygen, sulphur, carbon, nitrogen, and chlorine. These ions are the agents of potential corrosion. <u>Corrosion</u> and tarnish are the major metal object conservation problems.

3. <u>Identifying Active Corrosion</u>

The primary causes of corrosion in the museum or historic furnished structure are <u>relative humidity</u> and <u>air pollution</u>. The simple act of mopping a floor with a detergent solution containing ammonia will add both humidity and a corrosive agent to the museum environment. Metals also have the property of not retaining heat. For this reason the temperature of a metal surface and the air surrounding it may be slightly cooler than that in the museum exhibit or storage space. As a result, the relative humidity closest to the surface will be higher than that in the rest of the space.

Corrosion, tarnish, and patination are all examples of metal compounds, some of which are unintentional and are considered to be disfiguring. Others are deliberately created for an aesthetic effect. While some forms are more protective or stable than others, almost all are subject to failure at some critical relative humidity level or in the presence of certain pollutants.

The presence of a corrosion product on an object is not indicative of active corrosion. Corrosion rates vary according to environmental factors and the thickness of the corrosion film or crust. Typically, corrosion rates will be very high initially and gradually taper off as the corrosion layer develops. If conditions are dry enough, and

the atmosphere is pollution free, corrosion may be brought to a complete standstill. Most forms of corrosion that occur in the museum or historic furnished structure, will be generated at or near the surface of the object.

Active corrosion products can be visually identified by the following general evidence:

- color (wet or dry in appearance)

- powdery or flaky formations on the surface of the object and similar deposits around the base of the object

- loosely adhering formations, frequently appearing in patches on the surface as opposed to uniform, dense well-adhered deposits

- continuing change or growth

The following discussion provides specific guidance on identifying corrosion on the different types of metals.

a. Iron and Steel

The surface of objects made of iron and steel may vary from highly polished surfaces found on armor and swords, to dull blue/black finishes found on utilitarian cast and wrought iron objects. Active corrosion products will usually be orange to reddish brown in color. If these formations appear wet or glossy, there is a strong possibility of active corrosion. Hard, black corrosion products on iron are usually stable. Surface moisture and high relative humidity are the primary causes for most iron corrosion.

b. Copper and Copper Alloys

The surface of objects made of copper and copper alloys range from yellow to rich browns and blacks. Certain copper alloys such as German silver have a white (silver) color. Corrosion products are green, blue, red, black, and occasionally white. Powdery green, blue, and white corrosion products are generally indicative of active corrosion. White spotty formations may be the selective corrosion of lead or tin components in a copper alloy. Typical corrosive agents for copper and copper alloys in the historic furnished structure or museum are fumes from various cleaning agents, brass polish residue, storage or exhibit case materials (e.g., woods, adhesives, and paints), and air pollution.

Other typical copper corrosion agents are saddle soap, leather dressing, candle wax, and linseed oil. These products contain fats known as stearates, that react with copper to form a green copper stearate compound. This corrosion product is often slightly transparent and may have a waxy or oily appearance.

c. Tin and Tin Alloys

Pewter, an alloy of tin, copper, antimony, and occasionally lead, is the most common tin alloy found in a museum collection. There are many popular misconceptions about this metal. Tin was also used as a coating on sheet steel, to prevent it from rusting. There may also be many examples of tin ware in park museum collections. Typical corrosion products are white, gray, and dark gray to black. The tin oxide coating which develops on the surface of pewter objects is responsible for the dull gray appearance. The layer is extremely hard--much harder than the underlying metal. If dropped the layer can crack. Frequently, corrosion sites develop under the gray film and swell upward forming nodules that can break through the harder corrosion crust and erupt, exposing a light gray or white corrosion product. At temperatures below 56°F, a change to the crystal structure may occur. This condition is referred to as tin pest or tin disease.

d. Lead

Typical lead corrosion products found in the museum range from white, to dark grey or blue black. Lead oxide forms very quickly on a clean lead surface and it is responsible for the dull bluish-gray color of lead. When freshly scratched, the underlying metal is silver in color. The oxide coatings which form on metals such as lead, tin, and aluminum are very hard, and under normal atmospheric conditions, act to protect the object. Once formed they tend to serve as a barrier which usually prevents further corrosion. These metals will, however, corrode, usually in the presence of pollutants such as organic vapors or chloride compounds. Hard woods (e.g., oak) contain tannates, acetates, and formates which will react with lead. A heavy white formation is characteristic of lead objects that have been stored or exhibited in older wooden exhibit cases or historic storage furniture. Certain adhesives, paints, and plastics found in new case construction will also result in the formation of lead acetate and basic lead carbonate.

e. Silver and Silver Alloys

Silver is frequently alloyed with copper and sometimes gold. Pure silver is generally too soft for most practical applications, so a small percentage of copper is usually added for strength. The exception is found in artifacts and jewelry made in Mexico and the American Southwest that tends to have a high silver content. Gold, because of its electro positive charge, will not normally corrode. Silver will readily tarnish in the presence of sulphur compounds. Like lead, silver is also subject to corrosion in the presence of organic vapors found in common hard woods. If allowed to progress, the surface of the object will be etched and pitted beneath the tarnish layer. Another common occurrence is the presence of finger prints, which if not removed, will become

etched into the surface of the metal. Green copper corrosion products are sometimes found on silver objects. This is because the copper in the alloy may be preferentially corroded. Green copper corrosion products may also be indicative of a plated object, or of a laminated sheet silver, sheet copper process known as Sheffield plate.

f. Nickel and Nickel Alloys

Nickel and nickel alloys were used in military accoutrements, weapons, tools, architectural hardware and decorative hardware.

Nickel is also found in scientific instruments and precision machine parts. It is a metal which is slightly magnetic. Therefore, a magnet is useful in its identification. It is usually stable, but is adversely affected by certain pollutants. The typical corrosion product is reddish brown, and appears much the same as iron rust. As with silver, copper can be preferentially corroded from an alloy, resulting in a green corrosion product formed over the white metal substrate. Nickel was often plated over base metals such as iron and steel, and brass. Nickel corrosion products may develop from a brass base metal, or from a copper substrate which was commonly plated over iron and steel, prior to the final plating of nickel.

4. <u>Ferrous Metals and Their Alloys</u>

Ferrous metals are cast iron, wrought iron and steel. Ferrous metals have a long, complex and important history. Meteorites may well have been the first naturally occurring source for iron; a particularly good source because meteorites contain high percentages of nickel and are comparable to modern day high strength steels.

Wrought iron was developed in the Mediterranean Region between 1200 BC to 1000 BC in response to limited supplies of bronze for weapons, and perhaps as an inexpensive substitute. Iron ores constitute about one-twentieth of the Earth's surface. Cast iron was produced in Germany about 1350 AD, although it was known and worked in China, centuries earlier. Steel alloys were developed during the mid-nineteenth century. Much of the history of ferrous metals is concerned with additives to the iron, both intentional and unintentional, and with processing techniques.

a. Cast Iron

Pure iron was unmeltable in any furnace available prior to the nineteenth century. If iron is heated in a fire long enough to absorb carbon from the charcoal fuel, it changes properties greatly, becoming first steel, then cast iron which is not much more difficult to melt than copper. The melting point of cast iron is between 1,832°F and 2,372°F. The presence of carbon in

cast iron was not discovered until 1774. Cast iron contains approximately 2% to 4% carbon. The carbon is in the form of graphite flakes which are distributed through the iron matrix.

Cast iron during the seventeenth, eighteenth, and early nineteenth centuries in Western Europe, and in the North America was produced in large stone furnaces, that were charged with hardwood charcoal (fuel), limestone (flux), and iron ore. A forced draught was used to achieve the necessary temperatures for the reduction of the iron ore. The molten cast iron would pool in the bottom of the furnace and eventually be run out into sand molds or often into ingot shapes which were carved into the sand floor in front of the furnace. The ingot shapes were called pigs and sows. The pigs and sows were further worked at bloomeries to produce wrought iron.

The establishment of iron foundries along the eastern seaboard of North America in the seventeenth century was encouraged by the English Crown. This was due in part to dwindling timber resources in England; timber which was strategically important as naval stores. The English colonies had an abundance of hardwood forests from which they could produce charcoal for the refining and casting of iron ore. An iron works was established and producing iron at Falling Creek, Virginia before 1622. The effort was however, short-lived. A more extensive operation was established in Saugus, Massachusetts by the 1640's.

These early foundries produced ingots and simple wares such as kettles and firebacks. By the third quarter of the eighteenth century larger iron plantations, such as Hopewell Village in Pennsylvania, could produce iron cannon tubes. By the outbreak of the Civil War, large plants such as the Tredegar Iron Works in Richmond, Virginia, were turning out railroad locomotives and military ordnance.

Cast iron has excellent compressive strength, but poor tensile strength. The brittle nature of cast iron dictated which forms would be most suitable for production in cast iron. Typical forms included kettles, fire backs, bells, stoves, cannon tubes, and later in the nineteenth century, structural columns, decorative building facades, machinery, hardware, and fence components. Normally cast iron is more resistant to corrosion than wrought iron. The two metals can usually be distinguished by close surface examination. Cast iron has a cast texture which will often contain impurities such as slag or sand, and very often voids resulting from trapped gases. Wrought iron has a grain like structure, similar to a wood grain that is a result of hammering, or forge work. Gaseous voids and impurities contained in cast pigs and sows are flattened and worked into the grain-like matrix.

The more common problem associated with cast iron is fracture. This can result from either design configuration or improper handling.

b. Wrought Iron

Wrought iron has a low carbon content, compared to cast iron, usually no more than .035%. Wrought iron will also contain traces of silica. Wrought iron is shaped by heating and forming over anvils with hammers. It is possible to produce wrought iron directly from iron ore, without first melting the ore. Japanese and Damascene swords were made in this manner. Wrought iron is very malleable, possesses both elasticity and tensile strength, and unlike cast iron, it is easy to weld. Wrought iron will also corrode more readily than cast iron. Wrought iron was used for architectural hardware, weapons, tools, kitchen utensils, and many types of fasteners.

c. Steel

The primary distinction between steel, and cast and wrought iron is the carbon content. Steel generally has a carbon content between about 0.1% and 2.0%. Modern alloy steels also contain other metals such as chromium, nickel, manganese, titanium, and vanadium. A secondary distinction is temporal.

Even though cast iron and malleable alloys of steel can be obtained which are similar to historic wrought and cast iron, the modern day alloys are different in character. Present day metallurgical processing techniques are more precise and the quality of the raw materials much purer. Many of the steels currently available have been developed for specific applications.

5. Nonferrous Metals

a. Copper and Copper Alloys

Copper and copper alloys were among the first metals to be widely used by mankind. Metallic copper does exist in the natural state and was worked by native peoples of North America. The first bronzes to be worked were probably obtained from ores containing both copper and tin compounds. The controlled addition of tin to copper began as early as 3800 BC in Egypt. It is generally a good practice to refer to brass and bronze as copper alloys. Brass is an alloy composed primarily of copper with a small percentage of zinc. Bronze is primarily copper with a small percentage of tin. Other elemental metals alloyed with copper are nickel, lead, arsenic, and antimony.

In many instances it is difficult to determine whether a given object is brass or bronze by simple visual inspection. Identifying the method of manufacture can be of help. It is much

more difficult to determine the alloy of a corroded object since the corrosion systems of all copper alloys are similar. The historic record is also unreliable, since the common confusion between brass and bronze is to be found in written accounts. A reference to a brass cannon may in fact be to a bronze cannon. There are non-destructive methods for determining the composition of an alloy. There are times when such information is important.

b. Brass

Brass is an alloy of copper and zinc. The element zinc was not known in Europe until the second quarter of the eighteenth century, although the Romans used brass extensively. In 1738, William Champion patented a distillation process for zinc in England. His information was probably obtained from the Orient where zinc in a pure state had been known from at least the fourteenth century. Prior to Champion's patent, brass in Europe was made by smelting copper in the presence of calamine, a zinc silicate. It was not until 1781 that the modern method of brass production was developed.

Brasses can be yellow in appearance. However, some brasses are red and others are white, depending on the alloy. Paktonk, an example of a white brass, is primarily copper and zinc, but it also contains nickel which is responsible for the white color. A common white brass, likely to be found in park museum collections is German silver, which was often used in the manufacture of weapons, tools, instruments, and sometimes decorative items. These alloys have good corrosion resistance, are tough and can be polished to a bright silver color. Figure 0.1 lists several brass alloys.

Yellow Brass 70 parts copper 30 parts zinc	Tombac 16 parts copper 1 part zinc
Pinchbeck 80 parts copper 20 parts zinc	Paktonk (silver color) 50.5 parts copper 32.5 parts zinc 15 parts nickel
Pinchbeck (for watches) 4 parts copper 3 parts zinc	Paktonk (yellow-green) 57.9 parts copper 32.2 parts zinc 7.7 parts nickel
Emerson's Brass 1 part copper 8 parts zinc	German Silver 50 parts copper 25 parts nickel

Figure 0.1. List of Several Brass Alloys

c. Bronze

Bronze alloys are predominately copper with small percentages of tin added, although in some bronzes, zinc is also added. Bronze is a much harder alloy than brass and was readily used in forms where strength was a primary requirement. Casting is the usual manufacturing method when working with bronze, whereas brass, which is softer and more malleable, could be cast or hammered into shape. Figure 0.2 lists some bronze alloys.

Gold Bronze 90 parts copper 7 parts tin 3 parts zinc	Gun Metal 90 parts copper 10 parts tin
Bell Metal 80 parts copper 20 parts tin	

Figure 0.2. List of Bronze Alloys

d. Tin and Tin Alloys

The most common tin alloy found in park museum collections is pewter. Tin is always the element of highest proportion in pewter. Copper, antimony, bismuth, lead, or zinc may be added to tin. The distribution of tin ores worldwide is uneven. Primary deposits of tin are located in England, Malaysia, and Bolivia. The scarcity of tin may have been one of the factors that contributed to the replacement of bronze weapons with iron weapons at the end of the Bronze Age.

Scarcity may also be responsible for the addition of lead in more functional pewter alloys, such as that used for organ pipes. A small percentage of lead improved the pouring properties of the tin alloy. Pewter was usually cast, although in rare instances a craftsman might hammer an entire piece. Hammer marks on a piece of pewter do not necessarily indicate that the piece was hammered. Frequently plates were cast, and then hammered to strengthen them. The act of hammering creates stress in the metal which serve to work-harden it. Even with the addition of hardening agents (e.g., copper and antimony), pewter alloys are quite soft and, therefore, the range of items manufactured from this metal was limited. The rat-tail common to pewter spoons of the seventeenth and eighteenth century is a structural feature that reenforced the junction between the bowl and the handle. Lead in an alloy of pewter has always been undesirable because it lowers the quality of the alloy, it causes the alloy to turn very dark, it can cause lead poisoning when used in conjunction with acidic agents (e.g., citric acid) or alcohol. Among popular misconceptions about

pewter are that pewter is mostly lead, and that many colonists died of lead poisoning.

During the seventeenth and eighteenth century, the Royal Company of Pewterers in London established standards and monitored the quality of pewter alloys. Fine alloys of pewter contained no lead and were marked accordingly. The Guild's control did not extend to the colonies, and the importation of raw materials (e.g., tin) was generally prohibited. Consequently colonial pewter was often recycled when it was damaged or out of fashion. Finer English pewter continued to be imported into the colonies. Figure 0.3 lists some of the pewter alloys.

Modern Pewter 90 parts tin 8 parts antimony 2 parts copper	Trifle 83 parts tin 20 parts lead
Fine Pewter 112 parts tin 26 parts copper	Ley 80 parts tin 20 parts lead
Plate I or Queens Metal 100 parts tin 4 parts copper	Organ Pipe 60 parts tin 40 parts lead
Plate II 112 parts tin 8 parts antimony	Britannia 150 parts tin 3 parts copper 10 parts antimony
Plate III 90 parts tin 2 parts copper 6.7 parts antimony	Limoges 10 parts tin 4 parts lead
Montpelier 90 parts tin 10 parts lead	Spoon 95.6 parts tin 1.06 parts copper 3.64 parts lead

Figure 0.3. List of Pewter Alloys

e. Silver and Silver Alloys

Pure silver is too soft for most purposes, therefore, copper was added as a hardening agent. There are several silver alloys, sterling silver being the most common. Electro-plating was not developed until the nineteenth century. Articles made of solid silver were frequently referred to as silver plate in wills and

inventories. The first popular and successful method of bonding a thin sheet of silver to a base metal of copper was perfected in 1742 by Thomas Boulsover of Sheffield, England. Sheffield plate is actually a process of lamination where two sheets, and sometimes three, of silver and copper are bonded together and then worked as if they were one. Sheffield plate can be identified at the edges of an object where the lamination is most obvious. Electro-plating appeared during the 1830's. By 1845 "Elkington's plate" or P.N.S. as it was then known began to appear in profusion on many Victorian sideboards. This early electro-plating was accomplished with batteries. Figure 0.4 lists some silver alloys.

Sterling Silver 92.5 parts silver 7.5 parts copper	Britannia 95 parts silver 5 parts copper
Coin Silver 90 parts silver 10 parts copper	Electrum 50 parts silver 50 parts gold

Figure 0.4. List of Silver Alloys

6. <u>Surface Treatments</u>

a. Plating

Plating, a process by which a metal or an alloy is deposited over a base metal, is done for decorative reasons or for functional reasons (e.g., improving corrosion resistance). Electro-plating, the most common method, is accomplished by immersing the object in a solution of metal salts. Plates of the metal to be plated are also immersed in the tank and electrical charges of opposite polarity are applied to the object and the plates. Metal ions are electrically pulled from the solution and deposited on the object. Careful inspection of the edges and the base of an object will often reveal whether the piece is plated or not.

A process frequently found on colonial silver is mercury gilding. This method is accomplished by mixing a paste of gold and mercury that is brushed onto the surface of a silver object. The object is then placed in an iron vessel and heated. The mercury vaporizes and a thin layer of gold is deposited onto the silver. The gilding can be built up to a dense layer by repeating the process, or left thin and semi-transparent. It may also be applied locally, for decorative effect.

A third plating technique is accomplished by dipping a solid metal object into a tank containing molten metal or by brushing molten

metal over a surface. This technique was frequently used to coat sheet steel and copper with lead, tin, or zinc.

b. Patination

Intentional patination is accomplished by the application of chemical compounds to a metal surface. The chemical is allowed to react with the metal surface to form a dense, uniform metal compound. Heat is frequently applied to accelerate the reaction. The technique may be done for decorative reasons or to improve corrosion resistance. Bronze sculpture is usually colored in this manner. Similar techniques are frequently used industrially to inhibit corrosion and are referred to as conversion coatings.

c. Coatings

Clear coatings are often applied to metal surfaces to prevent corrosion. During the nineteenth and early twentieth century, many lacquers were pigmented to mimic the rich brown and red tones of bronze. Tin ware and brass were often colored in this manner. Another common metal treatment found in park museum collections is tole ware. Tole ware is tin ware which has been decoratively painted.

d. Mechanical and Chemical Finishes

Metal surfaces can be polished or burnished to create a high bright metal surface. Alternatively, metals can be etched chemically to create a matte finish. Matte finishes can also be created with air abrasive techniques. Both techniques can be used to create contrast. Mechanical finishing techniques serve to work-harden a metal surface and thereby make it more resistant to corrosion. An etched surface is rough. Therefore, it provides a greater surface area for corrosion to take place on than does a polished metal surface.

e. Engraving and Chasing

Engraving and chasing are similar in that they are both used to decorate a metal surface. The engraved line is created by pushing a fine, sharp metal tool, called a graver, through the surface, cutting metal away. The chased line is created with a blunt tool that is tapped into the metal surface causing a depression.

7. <u>Common Manufacturing Techniques</u>

a. Casting

Casting is accomplished by melting the metal and pouring it into a mold. Alloys are easier to cast than pure metallic elements. Pewter has a low melting point and pouring temperature (below 700°F), and, therefore, can be cast into a bronze mold. The

melting point of bronze is much higher than the pouring temperature of pewter. A bronze mold can be used repeatedly. Copper alloys, silver alloys, and iron have high melting points and pouring temperatures (in excess of 2,000°F), and must be cast into materials which can withstand high temperatures. Sand is such a material, and was commonly used to make molds. The sand mold can only be used once, because the mold is destroyed when the rough casting is removed. Another common mold material is "investment", a plaster-like material used in the lost-wax casting process for sculpture and jewelry.

b. Stamping

Stamping is accomplished by impressing a design into sheet metal with a metal die. A familiar example is the back plate on many furniture drawer pulls. Brass is frequently worked in this manner. Stamped articles are characteristically thin.

c. Repousse

Repousse is similar to stamping. In this process sheet metal is pushed into the desired shape, often with hammers. The copper of the Statue of Liberty was formed by hammering large sheets of copper into or over wooden forms.

d. Raising and Planishing

This technique is often used in the forming of sheet silver, and to a lesser extent, sheet brass and copper. It is accomplished by hammering the sheet metal over highly polished anvils of varying shapes. Raising and planishing hammers come in a variety of shapes, and their faces are highly polished. The body of silver coffee and tea pots were frequently made by this manner. Handle parts, feet, and the spout would be cast and then soldered onto the hammered body. The technique, when accomplished by a silversmith, is so fine that the hammer marks are extremely difficult to discern. Other typical forms made in this manner are silver bowls, tankards, goblets, and ladles.

e. Forging and Die Casting

This technique is most often used in the forming of wrought iron and steel. The metal is heated in a forge or furnace and hammered into shape. Die casting is similar to stamping, but the metal ingot is heated in a furnace prior to being stamped in a metal mold. A familiar tool made in this manner is the crescent wrench.

f. Spinning

Spinning is another sheet metal forming technique for malleable metals such as silver, copper, brass, pewter, and aluminum. A wooden form is clamped into a lathe and a circular disk of sheet

metal is clamped against the form. As the lathe turns, the disk is gradually pressed over the wooden form with a steel tool, to form the object.

g. Machining

Machines developed for the shaping of metal stock include the lathe, the planer, the milling machine, the drill press, and the grinder. Frequently these machines are used to finish rough castings and die castings.

C. AGENTS OF DETERIORATION

Metallic objects can be readily damaged by improper storage or exhibit conditions. Common problems include poor support, high relative humidity, air pollution, and incompatible storage cabinet or exhibit case materials. Hardwoods such as oak can evolve acidic vapors that corrode lead and silver. A commonly observed deterioration in older museum cases is the formation of a white lead corrosion compound (e.g., lead acetate and lead carbonate) on lead artifacts such as minie balls. The adhesives, paints, woods, and textiles used in more recently constructed cases have resulted in similar problems. Additionally, storage and exhibit case construction afford an opportunity to implement a wide range of preventive conservation procedures that result in the creation of micro-environments that are conducive to metal conservation. Inorganic materials such as metal are generally considered to be more stable than organic materials, and objects that are of all metal construction are considered less problematic than composite objects.

Metal is an inherently reactive material, but in most instances there will be environmental factors (e.g., high relative humidity or air pollution) that contribute to the corrosion process. <u>An important axiom to remember in caring for metal objects: Do not just treat the symptom, but address the cause of deterioration</u>.

The most commonly occurring problem of metal objects is corrosion. Corrosion can take several forms depending on the metals which comprise the object, the manner in which they are joined, and the environment in which they are exhibited or stored. At times, the corrosion source may be incorporated into the metal itself, such as chloride contamination of metals recovered from a maritime underwater site. In other instances, the agents responsible for corrosion may be an integral part of the environment, such as a seacoast or polluted urban air. Traditional methods for maintaining metal objects are often inappropriate for the historic metal object. For example, the continual application of commercial brass polishes to an object can cause the loss of fine surface detail.

The most commonly observed mistreatments of metal objects are over-cleaning and neglect. Over-cleaning often results from a desire to have metals bright and shiny, especially for brass and silver objects on display in a historic furnished structure. A "Sunday Best" attitude developed in our youth, or maybe, a "Spit and Polish" attitude developed from military experience are not appropriate approaches to the care of metal objects. Archaeological artifacts are often over-cleaned because of a desire to see what is under the layer of corrosion, or because of the mistaken assumption that corrosion is like a "cancer", and unless every last bit of it is removed, the object will continue to corrode. Unfortunately, such intense treatment has resulted in the loss of information, and the inclusion of harmful chemical residues that generated further corrosion. Conversely, neglect is often responsible for

irreversible damage to the metal object. Until very recently, the green and black corrosion products commonly observed on bronze sculpture were mistakenly believed to be protective by some people.

There are certainly instances in which the corrosion layer is protective, aluminum oxide being but one example. Unfortunately, most historic metals do not form protective corrosion layers. However, historic objects that have corroded are best left untreated until a metals conservator has had an opportunity to examine them, otherwise, there remains the risk of over-cleaning, and the consequence of higher corrosion rates on freshly exposed metal surfaces remains. Conditions seldom remain static, so when an object appears to be stable, monitoring and maintenance are essential elements of the collection maintenance program.

A precedence for appearance and a failure to understand the corrosion process has resulted in another form of mistreatment. Objects have been sent to conservators for treatment and then reinstalled under the same conditions which were responsible for the initial damage. Conservation treatment is frequently the wrong option for many objects. It is labor intensive, time consuming, and expensive. Treatment is never a permanent solution to the long term preservation of an object, and even if treatment were, there will never be enough conservators to treat all the objects that need attention. As with other types of museum object materials, <u>practicing preventive conservation is essential</u> to the curatorial care of metal objects.

D. PREVENTIVE CONSERVATION

There are practical methods for the care and maintenance of the majority of metal objects. An object which is in an active state of deterioration can frequently be stabilized by isolating it from harmful agents of deterioration. The first step in proper care is to understand and to control, to the extent feasible, the harmful environmental factors (e.g., relative humidity and air pollution). A second, more manageable step is to ensure that the proper exhibit cases or storage cabinets are used. Cabinets can easily be conditioned with desiccants such as silica gel, pollutant absorbing material such as activated charcoal paper, and/or vapor phase corrosion inhibitors. The third step focuses on the object itself. A program of care may include the application of wax coatings.

With appropriate training by a conservator, curatorial staff can be trained in coating metals with wax. The scope may be expanded to include other barrier materials or corrosion inhibitors. This type of treatment is especially applicable for objects stored or exhibited outdoors. Interventive treatment, the third course of action, must be deliberate and calculated. It is important to understand the properties of the selected materials and the mechanism by which such materials impart protection against corrosive elements.

1. Rules for Handling Metals Objects

All of the general rules for the safe handling of three dimensional museum objects apply to metal objects. Refer to Chapter 6 for general guidance on handling museum objects. Two special concerns for metals are weight and skin contact with bare metal surfaces.

a. Keep movement and handling to a minimum. Frequent handling increases the risk of eventual damage. One method to reduce the need for frequent handling is to apply protective coatings so that objects will not have to be polished on a regular basis. Objects made of precious metals, such as sterling silver, are often put into drawers or safes during the night. This practice greatly increases the chances for damage and wear. If such frequent handling is necessary, prepare special padded trays and carrying boxes.

b. Whether the object is going a long distance or only a few feet, plan each move. Metals are heavy. The inadvertent placement of a metal object on another object or on a period piece of furniture may result in dents, scratches, or staining.

c. The site to which the object is to be moved should be prepared before hand. Space should be cleared, and an inert buffer such as mylar or blotting paper put down prior to the move. The route of movement should be free of obstacles.

d. Metal objects can be heavy. Surfaces may be smooth or rough. Transport heavy metal objects by using carts or dollies. Padding for the metal object is essential. Baskets with soft padded cotton linings are an ideal way to move metal objects in the historic furnished structure. A variety of gloves should be kept on hand. Smocks without buttons should be worn when working with metal objects. The smock prevents the scratching of objects by belt buckles and other accessories, especially in those instances when the object is large and likely to be held against the torso during a move.

   In addition to cotton gloves, other types of gloves should be kept on hand. Polyethylene gloves are useful when polishing or waxing a metal object. If there is concern that the metal surface may be too slippery for cotton gloves, or that a rough metal surface may snag the cotton glove, place the object into a padded tray or box for transport. Always minimize the length of time that the object is hand-carried. Avoid long drop distances. If it is necessary to pick up an object for inspection, hold it over a table or some similar piece of furniture, and not over the floor. Also have on hand a jeweler's cloth for uncoated gold, silver, copper alloys, and highly polished steels. If an object has to be handled or is inadvertently touched, any finger prints can be easily buffed away with the jeweler's cloth. These cloths usually contain a fine abrasive.

   The advantage of the jeweler's cloth is that it permits localized polishing, without the mess of liquid or paste polishes. Some polishing cloths contain no abrasive and rely on the stiffness of the weave for their polishing effect. Any clean, soft cloth may be used to buff an object after a move or handling. Jeweler's clothes are available at many jewelry stores.

e. Know the surface of the object: Objects which have a wax or resin coating may be slippery. Cotton fibers from gloves may adhere to the surface of the object. The coating may be easily scratched or rubbed away during the move. Following the move, inspect the object, if necessary, locally reapply the coating.

2. <u>Environment</u>

   a. The lower the relative humidity the better. Steels will not rust and brass will not tarnish below 15% RH. This is not a practical solution for metal objects in the historic furnished structure, but it may be for objects in storage cabinets or exhibit cases. Ambient temperatures between 60° to 80°F are appropriate for most metals. In salt air environments, to inhibit active corrosion, metals should be housed in spaces that do not allow relative humidity levels to exceed 35%.

b. It is generally a good idea to avoid low temperatures for most metal objects, since low temperatures usually result in higher levels of relative humidity, and the possibility for condensation to form upon metal surfaces. Low temperatures should be avoided for tin alloys.

c. Most forms of air pollution are corrosive. Polluted urban air and coastal environments are among the more severe areas. Dirt and dust may contain chemical compounds that will react with metals and trap moisture close to the metal surface.

3. Storage Techniques

a. To the extent possible house metal objects in an indoor environment to reduce the possibility of corrosion.

b. Keep all metal objects together. Further isolation can be made according to metal type, object size, and object type.

c. Never store metal objects directly on the floor, or in close proximity to exterior walls. Avoid storing metal objects in attics and basements. These spaces are conducive to condensation.

d. Most metals are not adversely affected by visible light, ultra violet radiation or infrared radiation. However, coating systems may be affected by light. Metals are normally immune to biological attack, however, the droppings of pigeons, mice, and even insects will cause pitting and corroding of a metal object's surface.

e. Steel shelving is preferred over wood shelving because it is stronger and it does not emit harmful vapors. Line shelves with an inert, nonabsorbent material such as expanded polyethylene. Loosely drape over shelves clear polyethylene to protect metal objects from water leaks, dust, and air pollution.

f. The standard museum specimen cabinet provides an excellent method to establish the ideal microenvironment for the preservation of smaller metal objects. Place objects in trays that are padded with expanded polyethylene (ethafoam). Arrange objects so that they do not bump into other objects when the drawers are opened and closed. The cabinets can be conditioned with the following materials:

1) Activated Charcoal Paper: Activated charcoal absorbs air pollutants. Two sources for this material are the 3M Company which markets "Silver Protector Strips", and the Mead Paper Company which produces "Getter" activated carbon paper. The charcoal paper can be reactivated in an oven.

2) Silica Gel: Silica gel can be used to reduce and to buffer the relative humidity of an enclosed space. Refer to Appendix I for guidance on the use of silica gel. The bags must be monitored and reconditioned as necessary, otherwise, bags of silica gel can become saturated and serve as a source of moisture.

3) Vapor Phase Inhibitors: These materials release a vapor which inhibits corrosion. Some of these compounds may be health hazards if breathed for long periods of time. Consult a metals conservator concerning application.

g. Clear polyethylene bags provide an opportunity to create microenvironments, as well as an easy means for monitoring conditions inside the bag.

h. Passive storage techniques must be monitored and maintained. Separate metals in storage should be kept away from hygroscopic materials such as paper, textiles, and wood.

i. Closing the historic furnished structure for winter represents a special problem for metals. Wintertime temperatures should never be allowed to fall below freezing in the historic furnished structure.

j. Move metal objects to the center of rooms, away from exterior walls, fireplaces, and entry halls. Loosely drape polyethylene over metal objects. The transitional period between winter and summer is a time when condensation will be most likely to occur.

4. <u>Exhibit</u>

a. Environmental Concerns

Conditions within the exhibit space are usually more subject to change than those in the storage space. This is especially true for the historic furnished structure. Visitors add both heat and humidity to the exhibit space, especially moisture on a rainy day when visitors enter the house with damp clothing and umbrellas. Daily fluctuations will probably be greatest in the historic structure that lacks environmental control equipment.

Windows are a common feature in many visitor centers, historic houses, and newer museums. In addition to visible light and ultraviolet radiation, infrared radiation also will locally reduce relative humidity. Monitoring these conditions is very important. Some typical occurrences are:

1) Cast and wrought iron objects are often exhibited in hearths. Metal objects are displayed on mantles or hung on the fireplace. Fireplaces are great corrosion sites. Liquid rainwater may enter through the flue. Brick and mortar are

hygroscopic materials which trap moisture. Chimneys are usually cold. All of these conditions promote condensation and corrosion.

2) Seasonal transition periods, especially in the historic furnished structure, can promote condensation and corrosion.

3) Frequent cleaning of exhibit areas may add moisture and potentially harmful vapors to the environment.

4) Doors and windows which may be left open during warm summer months allow gaseous and particulant pollutants to enter the exhibit area. This is especially true of urban environments.

5) Dust is abrasive, can contain chemical pollutants, and is hygroscopic.

b. Exhibit Techniques

1) The exhibit case presents the ideal means for object preservation because it is generally of limited size, is usually sealed to some degree, and can be modified to contain a variety of case buffering materials. Exhibit case control can be either active or passive. <u>Passive techniques</u> employ trays of silica gel, pollution control agents, and vapor phase corrosion inhibitors. Active techniques usually employ small mechanical systems which may be built into a case, or connected to several cases to filter, humidify, dehumidify, and heat or cool the air. Electronic sensors can be concealed in the case to control and monitor conditions.

2) Lighting is an important consideration. Some fixtures such as fluorescent light ballasts or transformers may generate ozone. Ozone will cause corrosion on metal surfaces. Light fixtures should not be installed directly in exhibit cases.

3) Housekeeping procedures are an important element in the preventive conservation program. Many proprietary products contain ammonia, weak acids, or bases, solvents, waxes and fats which may have an adverse effect on metal objects. <u>Caution: The formulae of commercial products are subject to change without notice, so that a product which was once determined to be safe, may no longer be safe</u>. Techniques such as the frequent polishing of brasses and silver are usually inappropriate for metal objects. The techniques and materials used at home are often unsuitable for museum objects. Training and written procedures are required. Avoid the application of any traditional technique or material which is not thoroughly understood. Among popular techniques used in the past on metals are various oils such as linseed oil and fish oil, various fruit juices, vinegar, and animal fats.

5. Metal Object Coatings

Preventive conservation measures for metal objects will require hands-on methods. These measures should mitigate frequent handling of the object, be easy to apply and easy to remove, and be safe for both the object and the person applying the material. Wax is an example. Proper identification of the surface is very important. It may be desirable to ask a metals conservator to conduct a Collection Condition Survey that includes a section about routine maintenance. Refer to Chapter 3 for guidance on Collection Condition Surveys.

a. Typical Coating Materials

1) Waxes - Waxes are easy to apply, relatively safe, easy to remove and provide reasonably long term protection. Conservators frequently heat a metal object before applying the wax. This is not necessary. Most waxes suitable for use in an exhibit space can be applied at room temperature. Waxes will collect dust, are a food source for some molds and fungi, and may blanche or turn white. Waxes may be natural or synthetic. Natural waxes such as bees wax may be acidic. The metal object should be polished, washed, thoroughly dried, and buffed before waxing. A mild solvent such as Stoddard Solvent® or acetone can be used to remove the wax. Hot soapy water can also be used. A good technique for removing candle wax is to hold the object under hot, running tap water. However, use precaution when using this technique on pewter and other soft metals. Because the heat softens the metal, the object is more vulnerable to damage from bumping or dropping.

Refer to the Canadian Institute Notes 9/3, "The Cleaning, Polishing, and Protective Waxing of Brass and Copper Objects." This reference is listed in Section G of this appendix.

2) Lacquers - Lacquers, like waxes can be natural or synthetic. Generally, synthetic lacquers and waxes are considered to be more stable than those derived from natural products. Some of the commercial lacquers contain corrosion inhibitors, "Incralac" contains a copper corrosion inhibitor. Lacquers are harder than waxes and will usually last for five to ten years before reapplication becomes necessary. Lacquers are more difficult to apply and to remove than waxes. Certain solvents used in lacquers such as toluene and xylene pose health hazards. A metals conservator should be consulted, and asked to apply the lacquer coating or to train the staff in the use of these materials. Lacquers when properly applied will not adversely effect the appearance of an object.

The objections to protective lacquer coatings are not well founded. A common objection is that lacquers make a metal object look "plastic". Matting agents are available if necessary. Considering the wear caused by frequent polishing

or less frequent waxing, the lacquer finish provides the toughest and the longest lasting protection.

3) Corrosion Inhibitors - Corrosion inhibitors react with the surface of a metal object, thereby preventing corrosion. Some corrosion inhibitors are available commercially and others can be obtained from chemical supply houses, such as Fisher Scientific. They may also be incorporated into waxes and resins to provide an additional degree of protection should the wax or resin be scratched. Most corrosion inhibitors are metal specific. A list of corrosion inhibitors to be applied to specific types of metals is as follows:

COMPOUND	METAL
Benzotriazole (BTA)	Copper and Copper Alloys
Tannic Acid	Iron Alloys
Ethylene-Diamine-Tetraacetic acid	Iron Alloys
Mercaptans	Silver Alloys
Phosphoric Acid	Iron Alloys

Keep in mind that corrosion inhibitors are not fool proof. Any metal treated with an inhibitor is still subject to failure at or above the critical relative humidity for that metal. For that reason, coatings, inhibitors and environmental quality should be considered to be part of a system requiring maintenance. **No one treatment is permanent.**

CAUTION: Chemical inhibitors need to be applied by or under the direction of a conservator. Observe all health and safety precautions.

b. Application

It is not uncommon to hear complaints about a given conservation material. All too often, it is not the material that is at fault, but the method of application. Training is essential for the safe and successful application of lacquers and inhibitors to metal objects. Some basic considerations are as follows:

- Conduct work in a clean, properly lighted, well-ventilated work area.

- Properly maintain brushes and spray equipment.

- Keep lacquers, waxes and other materials clean and properly stored in an approved flammable storage cabinet.

- Use the appropriate safety equipment (e.g., gloves and respirators with correct cartridges). Refer to Chapter 11 for guidance on respirators.

- Learn how to look at your objects. Careful surface examination for abrasion checking, blanching, discoloration, flaking, and accretions is important. No protective coating will last forever. It will fail at some point in time, dependent largely upon environmental circumstances and how the object is handled or treated.

- All preventive conservation measures are subject to failure. Passive measures such as silica gel and activated charcoal are ineffective when those materials reach saturation. Coatings will eventually fail. Renewal of these materials and coatings is required as part of the collection maintenance program. **If these materials are compromised, and not replaced, the resulting damage to the object may be severe.**

E. METAL OBJECT CONSERVATION ISSUES

The conservation profession has suffered a number of controversies during its brief history, due in part to the fact that the discipline is part science and part craft. Controversial metal conservation treatment issues are <u>glass bead peening, electrolytic reduction, the use of the corrosion inhibitors benzotriazole and tannic acid, and repatination</u>. When metal objects require treatment beyond preventive measures, consider the following points:

1. No one conservator is the expert. Don't be afraid to get a second opinion.

2. Never experiment on the park's metal objects, or let others experiment on the park's objects.

3. Exercise curatorial responsibility--be a part of the conservation decision-making process. Be objective, not subjective. Refer to Chapters 3 and 8 for guidance.

6. There will often be several treatment procedures which will be appropriate for a given problem. Widen this range as much as possible. Encourage creative thinking.

5. Remember that no treatment or material is inherently "good" or "bad". The successful treatment results from the proper analysis of the problem, the selection of materials and techniques most suitable to that particular problem, the skillful execution of the treatment, and the documentation of the treatment process.

6. Recognize the ongoing need to maintain objects that have been treated by a conservator.

F. EMERGENCY PROCEDURES FOR METAL OBJECTS

Metals are very reactive materials. In an emergency situation the typical form of degradation, corrosion, can cause irreversible damage to organic materials, therefore, complicating their salvage. Refer to Chapter 10 for guidance on emergency planning and to Chapter 8 for general guidance on response to emergency situations that involve museum objects.

If the metal object has survived the fire and the deluge of water, if it has survived the flood, or if it has survived the storm, the first course of action is to isolate it from another materials. Other actions include:

- Implement security precautions for precious metals and objects of intrinsic value such as sculpture.

- Provide a secure dry storage area for all metal objects.

- Do not attempt to treat museum metal objects.

- Have a metals conservator provide a Collection Condition Survey that documents each object's condition, recommends needed conservation treatment, and outlines remedial preventive conservation procedures.

G. GLOSSARY[1]

Abrasion:	The wearing, grinding, or rubbing away of surface material by friction, usually through the action of particulate matter (e.g., sand) or as a result of rubbing by people, animals, or plants.
Accretion:	The accumulation of extraneous materials on the surface of a buried artifact, sculpture, or monument. It may include core materials, deposition of insoluble salts, or even the heavy accumulation of dirt, grime, pollutants or bird droppings.
Acid Deposition:	The deposition of acidic constituents to a surface. This occurs not only by precipitation, but also by the deposition of atmospheric particulate matter and the incorporation of soluble gases.
Acid Precipitation:	Rain, snowfall, or atmospheric moisture below pH 7.
Alloy:	A metallic material composed of two or more elements intimately mixed.
Amalgam Gilding:	A process for applying gold to the surface of another metal, usually a copper or silver alloy by forming a paste of mercury and gold.
Annealing:	A process of heating and cooling sheet metal which has become work-hardened by hammering, spinning, or stamping in order to relieve stress and to return the metal to a malleable state.
Anode:	The positive electrode of an electrolytic cell at which oxidation is the principal reaction. Electrons flow away from the anode. Usually, the anode is where corrosion occurs and metal ions enter solution.
Bimetallic Corrosion:	Corrosion resulting from dissimilar metal contact; galvanic corrosion.
Brazing:	A method of joining nonferrous metals using a nonferrous alloy that melts at a lower temperature than that of the metals to be joined. Similar to soldering, the distinction being that soldering is accomplished at temperatures below 800°F, and Brazing is done above 800°F.
Bronze:	An alloy of copper and tin.

Bronze Disease: Copper corrosion in which chloride is the primary corrosive agent. It is rare. It may develop on archeological specimens or objects that have been recovered from the sea where chloride is present.

Burnish: A method that smoothes the rough surface of a metal by rubbing a hard stone or highly polished harder metal over the surface.

Casting: An object created by pouring molten metal into a mold.

Cathode: The negative electrode of an electrolytic cell. Electrons flow toward the cathode in the external circuit. Corrosion does not occur at the cathode.

Chasing: A metal finishing technique intended to sharpen the detail on an object or to add detail. With regard to sculpture, the term is expanded to include all finishing techniques.

Checking: Surface cracking in a checkerboard-like pattern, often associated with the degradation of a protective coating.

Chemical Conversion Coating: A protective or decorative nonmetallic coating created by the treatment of the metal with an acidic or basic compound. Examples are coatings on iron produced by tannic or phosphoric acid.

Coating: A protective barrier, usually a synthetic resin or a wax applied to a metal surface.

Corrosion: The electro-chemical degradation of a metal, due primarily to the loss of electrons, and the recombination of metal ions with other electro-negative elements such as oxygen, carbon, sulphur, chloride, and nitrogen.

Critical Humidity: The relative humidity above which the atmospheric corrosion rates of some metals increase sharply.

Electrolytic Cleaning (electrolytic reduction, electrolysis): A powerful method of cleaning metals, particularly if heavily corroded or salt contaminated. An object is wired to a low voltage direct current and is suspended between metal plates in a conductive solution. The object is made negative and the plates are made positive. Hydrogen is evolved from the metal surface which can convert some of the

corrosion to a metallic powder that can be brushed off. The physical action of the bubbling can also lossen accretions. <u>The dangers are that objects lacking a substantial core under thick corrosion masses can fall apart, that platings can be accidently stripped, or that long exposure to the hydrogen can lead to hydrogen embrittlement.</u>

Electroplating: The deposition of a metal from a solution of one of its salts onto a metal surface using an electrical current.

Electrotyping: A process identical to electroplating. However, electrotyping is used to build up thick metallic deposits on the interior of nonmetallic molds. It might be thought of as an electrolytic form of casting.

Embossing: Raising a design in relief on a surface.

Engraving: A decorative technique in which metal is removed by cutting into the surface with graves.

Etching: The production of patterns on a surface by the use of a corrosive chemical agent.

Ferrous: Metal alloys in which iron is the dominant metal.

Filigree: Decoration by means of wire, usually small, thin twisted wire, soldered together into an open work structure.

Finishing: The cleaning, polishing, patinating, and coating of metal.

Forging: The shaping of metal, usually steel and iron, by hammering while the metal is hot.

Galvanic Corrosion: Accelerated corrosion of a metal because of an electrical contact with a more noble metal.

Gild: To overlay with a thin covering of gold.

Glass bead peening: The dry blasting of a surface with glass microspheres.

Graver: A chisel-like tool used for engraving metal surfaces.

Inclusions: Particles of impurities, such as mold material, ferrous meal or slag.

Incralac:	A synthetic resin which contains the copper corrosion inhibitor, benzotriazole.
Intergranular Corrosion:	Preferential corrosion at or adjacent to the grain boundaries of a metal or alloy.
Inhibitor:	A chemical substance which prevents or reduces metallic corrosion.
Intervention:	The actions of a conservator taken to arrest the degradation of an artifact.
Lacquer:	An organic coating consisting of resin. The resin may contain matting agents or corrosion inhibitors. Some historic resins were pigmented.
Lost Wax Casting:	A casting technique which utilizes a wax model or pattern. A refractory mold material is used to cover the wax pattern. The mold is later heated, the wax melts. Molten metal is poured into the resulting hollow.
Metals:	Elements or mixtures of elements that possess high electrical conductivity and a lustrous appearance in the solid state.
Mold:	A form containing a refractory void (mold cavity) into which molten metal is poured during casting.
Nonferrous:	Metal alloys in which iron is not present.
Passive:	The state of a metal surface characterized by low corrosion rates.
Patina:	A colored layer on the surface of a metal, usually but not always copper alloys. The layer may be naturally occurring or artificially induced.
Planishing:	A forming technique utilizing stakes and highly polished hammers to shape sheet metal.
Plating:	A thin layer of metal deposited on the surface of another metal.
Raising:	Forming a hollow shape in metal by hammering on the outside surface over a dome headed stake or anvil.
Refractory Material:	Nonmetallic materials capable of resisting high temperatures.

Repousse:	A technique which by hammering from the inside produces raised areas on the outside of a sheet metal object.
Rust:	A corrosion product consisting of hydrated iron oxide; this term is properly applied only to ferrous alloys.
Sand Casting:	A casting technique in which sand is used as the refractory mold material.
Soldering:	The use of alloys that flow at low temperatures to join two or more metal parts that have higher melting points.
Spinning:	A forming technique in which sheet metal is pressed over a form on a lathe.
Steel:	An alloy of iron and carbon, with a carbon content between 0.1 and 2.0%.
Stress-Corrosion Cracking:	A cracking process that requires the simultaneous action of a corrosive agent and sustained tensile stress.
Tarnish:	Discoloration of a bright metal surface by a thin film of corrosion products, such as appears on silver or copper.
Tinning:	Covering a metal surface with tin.
Tin Pest, Tin Disease:	The deterioration of tin caused by change in the crystal structure at low temperatures (below 56°F, 13°C) from tetragonal white tin to diamond cubic gray tin.
Welding:	The joining of two pieces of metal at a temperature close to their fusion point.

H. SELECTED BIBLIOGRAPHY

Boyer, Howard E. and Gall, Timothy L., editors
1985 Metals Handbook, Desk Edition. Metals Park, Ohio: American Society for Metals.

Canadian Conservation Institute
1984 "Recognizing Active Corrosion," CCI/ICC Notes 9/1. Ottawa, Canada: Canadian Conservation Institute.

Canadian Conservation Institute
1983 "The Cleaning, Polishing, and Protective Waxing of Brass and Copper Objects," CCI/ICC Notes 9/3. Ottawa, Canada: Canadian Conservation Insitute.

The Canadian Conservation Institute Notes are available from:

Canadian Conservation Institute
1030 Innes
Ottawa, Canada
KIA OC8
613/998-3721

Mulholland, James A.
1981 A History of Metals in Colonial America. University, Alabama: The University of Alabama Press.

National Association of Corrosion Engineers
1988 Glossary of Terms. Houston, Texas: National Association of Corrosion Engineers.

Sandwith, Hermione and Stainton, Sheila (compiled by)
1984 The National Trust Manual of Housekeeping, Chapter 8, "Metalwork," 103-115. London: Penguin Books, Ltd. and the National Trust.

I. ENDNOTES

1. This glossary was prepared by excerpting selected terms and definitions from the Glossary of Terms, prepared by the National Association of Corrosion Engineers (1988). Copies are available from:

    National Association of Corrosion Engineers
    P.O.Box 218340
    Houston, TX 77218

APPENDIX P. CURATORIAL CARE OF CERAMIC, GLASS, AND STONE OBJECTS

APPENDIX P. CURATORIAL CARE OF CERAMIC, GLASS, AND STONE OBJECTS

A. INTRODUCTION

Glass, ceramics, and stone (all inert materials) are often erroneously considered non-problemmatic, requiring little more than a periodic washing. Although fashioned from durable materials, these inorganic objects are fragile and brittle. Preventive conservation such as proper handling and careful maintenance will add indefinitely to the lives of museum objects made of these materials.

National Park Service collections are extremely diverse as they represent the rich and varied material culture of this country. The glass, ceramics, and stone collections may contain a potpourri of object types including marble busts, ceramic bowls, glass vases, mantlepieces, clay figurines, reverse paintings on glass, or stone beads and tools. Alternatively, a collection may be very material specific and contain only Native American ceramics, Prehistoric arrowheads or presidential porcelain. Understanding the nature of these materials and how they were manufactured will aid the park curator in implementing the most appropriate course of action for each object's preservation.

Objects fashioned from inorganic materials are those most likely to survive in an underground context. Refer to Appendix I for special guidance on the care for archeological objects.

B. THE NATURE OF CERAMICS, GLASS, AND STONE

1. Materials and Manufacture of Ceramics

a. Material Makeup and Structure

The principal material in ceramic objects is clay. Clay is defined as a fine grained mineral (e.g., hydrated silicate of alumina), produced by the weathering of certain rocks. It is plastic when mixed with water and becomes rock-like when fired at high temperatures.

Very few clays found in nature are ready to be shaped and then fired. Clay must undergo an extensive preparation process to be made into a suitable clay body. Sometimes weathering is needed to further break down the clay particles. Other mineral materials are added to the principal clay to effect certain working characteristics. The final clay mixture is then subjected to wedging, or kneading to create a homogeneous body that is free of air pockets. A good clay body is composed of clay, nonplastic additive, and flux.

The mixture and proportion of materials can be manipulated to affect a clay body's working properties: color, texture, and firing reaction. Fluxes such as soda, mica, potash, magnesia, or lime serve to lower the firing temperature. Examples of nonplastic additives are organic materials (e.g., shell or plant fibers), volcanic ash, or bits of fired ceramic. These materials are added to make a usable body by reducing shrinkage during drying and firing, reducing the amount of water needed during formation, and increasing porosity.

1) Clay bodies

There are several types of clay bodies, each with distinctive characteristics.

Adobe is a heated but unfired clay-mud mixture that is used to make bricks. The bricks are sun dried. The heat is not high enough to cause a physical change in the body.

Earthenware is made from clay. These clay bodies are fired to a low temperature, generally between 950-1100°C, where vitrification (the progression of the clay to a glass-like state effected by firing) does not occur but the body does harden. (Terra cotta bodies, used primarily in architectural contexts, are made of the same low grade fired clay but are fired below 950°C.) A low-fired body will be structurally weaker than a high-fired body of comparable size. Earthenware objects are generally thicker than other wares because of this inherent weakness. They are soft and will scratch easily. A cross-sectional view of a glazed earthenware ceramic object shows that:

- it is porous and will readily absorb water unless it is glazed;
- the clay body is not glassy but may well be granular in appearance with numerous coarse particles;
- there is a clear distinction between the glaze layer and the ceramic body; and,
- the body is often red in color from the large amount of naturally occurring iron in the clay; brown, black, or yellow bodies are also possible.

Stoneware is made from a mixture of various clays but it is fired to a higher temperature so that the body begins to vitrify at approximately 1100-1350°C. Stoneware bodies have the following characteristics:

- they are partially vitrified and will absorb less water than low-fired ware;
- the body is harder, denser, and does not scratch easily as compared to earthenware;
- color ranges are buff, brown, or gray;
- when tapped lightly, the body will give a distinctive ring; and,
- the chemical bond between the glaze and body is strong.

Porcelain requires the highest firing temperatures to mature, generally above 1300°C, and has properties approaching those of glass. It is made of kaolin clay that is difficult to work without the addition of more plastic clay. The porcelain body is the most unyielding of the ceramic bodies, so the firing conditions must be precise. Though easily deformed, it is possible to create extremely thin, delicate ware. When fired, porcelains exhibit these characteristics:

- the body is completely vitrified and completely impervious to water;
- the ware is extremely hard and brittle;
- the body is white and translucent;
- when tapped, they have a higher ring than stoneware; and
- in cross-section, the glaze and body will be nearly indistinguishable.

2) Glazes

The majority of ceramic bodies are glazed in order to render the surfaces non-porous for utilitarian purposes or to provide decorative effects. The addition of glaze to the clay body makes the piece stronger. Glazes vary widely in appearance, with differences in color and texture derived from myriad combinations of oxides and additives. Most glazes fall into several distinct categories based on their chemical constituents. The types most commonly encountered are as follows:

Lead glazes are formulated around lead oxide. Lead oxide melts at a very low temperature. Depending on the combination of materials, lead-based glazes are usable at a wide range of firing temperatures. They are popular because of their easy application, reliability in firing, and potentially simple formulations. Lead glazes characteristically produce smooth glassy surfaces in a diverse range of colors and transparencies. Such low-fired ware is easily scratched since lead glazes are relatively soft. Another disadvantage of lead in glazes is a health concern. The danger arises when improperly glazed wares contact weak acids such as those contained in tomatoes, vinegar, and fruit juices. The glaze must be combined with a frit (e.g., glass powder) in order to render the lead insoluble. Lead that is properly fritted is nontoxic.

Alkaline glazes contain alkali fluxes (e.g., sodium, lithium, or potassium). They are fired at low temperatures. The characteristics of these glazes are brilliant coloration, a tendency to craze or crawl, and low durability. In addition to scratching easily, the glaze may also remain slightly soluble after firing, if the alkali is not adequately fritted.

High-fire glazes, used on stoneware and porcelain, have feldspar as the primary ingredient. High-fire glazes tend to be simple in formulation. In fact, feldspar can be used as a glaze by itself. The melting point of glazes increases as the number of fluxes in the formulation decreases. These glazes are quite glass-like, forming a hard, smooth, and durable surface. The color range is narrow and tends to be more subdued than in low-fire glazes.

3) Other surface treatments

There are a number of other surface treatments in addition to the basic glaze groups mentioned above.

An **engobe** is a thin layer of colored clay, also known as a slip, that is applied to the surface as a decorative element. The slip is applied to the surface of the object before the first firing. Since it is made of clay, it will have a matte appearance after firing rather than appear glassy like a glaze.

Underglaze colors are painted onto the surface of bisqueware (e.g., unglazed fired ware) then covered with a protective transparent glaze. Underglaze painting is generally used to add fine detail. The colors are derived from metallic oxides (e.g., cobalt or iron).

Overglaze decoration can be applied by two methods. In the first method, details are brushed onto a background of raw glaze and fired in one step. The various glazes meld into one another so that the design is somewhat soft in appearance. In

the second method the glaze details are applied onto a glazed surface and refired at a low temperature. Low temperatures allow a wide range of bright color but they are not as durable as higher-fire glazes.

A **luster glaze** (including gilding) is actually a thin layer of metal that has been deposited on the surface. The metal is derived from a metallic salt that is mixed with other materials that serve to hold it onto the surface in preparation for firing. Luster glazes are often fired during a second firing and should be considered somewhat fragile.

b. Production Processes

1) Forming Methods

A combination of methods can be used in the production of a single object.

Hand built ceramic objects can be created by several methods. A slab built object is formed when clay is rolled flat, cut into slabs, and assembled by pressing the edges together. A ball of clay can be pinched and manipulated to form relatively small objects. Clay can be shaped into ropes and coiled, then pinched together to form a vessel.

Wheel-thrown ceramics are formed when a lump of clay is hand shaped on a rotating wheel. The base of a wheel thrown piece is generally flat and often there are concentric striations on the surfaces.

Mold pressed ware is made by pressing a slab of clay into an open mold. This method works well for shallow ware (e.g., plates) that is difficult to throw.

Cast objects are made when a thin clay slurry is poured into an absorbant plaster or ceramic mold. The water is drawn out of the slurry, leaving the thickened clay on the sides of the mold. As the clay continues to dry it separates from the mold. The mold is removed and the freestanding body is fired. Delicate porcelain objects are often cast from molds.

2) Firing Methods

While there are several types of kilns used in the production of ceramics, the principle for the various designs is the same. The kiln is designed to house the objects, control the amount of oxygen and heat introduced, and hold the heat that enters the firing chamber.

The objective in firing a ceramic object is to fuse the clay together to give the body the desired hardness. Each clay formulation has a temperature range in which it can be successfully fired.

Firing can take place in one or a number of steps. In the course of firing, the clay body undergoes a series of chemical changes.

a) After the ceramic object is fully formed, it is allowed to air dry. Prepared clay can contain up to 25% water. This large proportion of water means that a certain amount of shrinkage is inevitable. Slow and even drying is important to prevent cracking of the body. Air dried objects are referred to as being in the leatherhard state. This initial drying stage allows the water between the clay particles to evaporate.

b) There are two types of glaze firing. Liquid glaze can be applied directly to leatherhard ware and fired. The body and the glaze vitrify together. This process is known as "through firing" and produces "once fired" ware.

   Most objects undergo multiple firings. The first firing is called the bisque firing. The ceramic object is heated to about 600°C that serves to strengthen and prepare the body for glazing. The second firing is the glaze and major firing. Liquid glaze is applied to the cooled bisqueware. Vitrification begins at about 800°C and progresses throughout the firing.

c) An additional low temperature firing is used when overglaze decoration, gilding, decals, and enamels are applied. The temperature range is about 600°-900°C.

3) Flaws in ceramic bodies and in glazes

It is important to know that flaws that have occurred in the clay body or glaze during firing are part of the manufacturing process and are not necessarily a sign of progressive deterioration.

a) Ceramic body flaws

   Warping may result with uneven heating or cooling during firing.

   Spalling or delamination of parts of the clay body can result if the firing temperature is not high enough.

   Sagging is caused by firing at a temperature that is too high for the clay body.

Cracking will occur if the object is cooled too quickly.

Bloating occurs when the heating is too rapid. The gases that are formed during firing do not have enough time to be released and are trapped in the body.

b) Glaze flaws

Numerous glaze flaws are a result of the mismatch of the glaze to the clay body. When combining a glaze and a clay body, the two parts should have compatible rates of expansion when fired and cooled.

Crazing appears as a fine network of cracks on the surface of the fired glaze. The crazing results when the glaze is under tension, that is, it is too small for the area it covers. The glaze contracts more than the clay body upon cooling. The crazing may be evident immediately or develop some time after firing. Other causes of crazing can be overfiring or too rapid cooling.

Shivering can be considered the opposite of crazing in that the glaze is put under compression by the clay body. The glaze may peel or flake off the surface. Shivering can be caused by a glaze composition that lacks sufficient high expansion alkali materials that contract more upon cooling causing separation.

Crawling is evident when the glaze shrinks together into islands, revealing bare areas of the clay body. The flaw may be apparent in isolated areas or the glaze may crawl entirely off the surface. The defect commonly results when the liquid glaze is applied over a dirty or greasy surface and the glaze fails to adhere adequately during firing.

Pitting in the glaze can vary in size, from pinholes to larger spots. These holes can occur in the course of a too short firing time which does not allow the gases or other volatile materials to fully escape before the glaze solidifies. Firing at a temperature too high for a particular glaze can also produce pitting. If the liquid glaze boils, pits can remain as the glaze cools.

Blistering results when air is trapped between the glaze and the clay body. These bumps are easily crushed. Glaze which is applied too thickly and already contains air bubbles will frequently blister.

2. Materials and Manufacture of Glass

Glass is a solidified liquid. A liquid is an amorphous material that does not have a crystalline structure. Most materials form a crystalline lattice during cooling from a liquid to a solid state.

The non-crystalline structure of glass results when molten glass cools quickly, while the molecular units are still disordered and do not have time to rearrange themselves into a lattice formation. The resulting material is "frozen" into a random network of molecular units.

Glass has characteristic properties of being rigid and brittle at room temperature, plastic at extremely high temperatures, and can be transparent, translucent, or opaquely colored.

a. Material Makeup and Structure

The basic composition of glass is the same as a glaze, though the proportions and particular ingredients will differ. The basis of glass is silica, often in the form of sand. Silica is fused with an alkaline oxide (known as a flux) that interacts with the silica to lower the melting temperature. These are usually oxides of lead, calcium, potassium, or sodium. The same colorants and opacifiers are used in both glass and glazes.

While glazes and enamels are true glasses, the distinction lies in specific material composition and firing temperature. Glass end-products, that are formed by casting or are mouth blown, must be made from glass that flows readily when molten. Glassy coatings must have enough body to adhere to surfaces that may be rounded, vertical, or otherwise irregular during application as well as firing. The addition of alumina to the formulation increases the stiffness of the glass. Glazes are generally fired at lower temperatures than those required for bulk glass making. Enamels can be considered glazes on metal and are fired at even lower temperatures than glazes on ceramic bodies.

b. Production Processes

A combination of hot and cold working techniques is used in glass production. In general, glass must be in its plastic condition to be shaped; therefore, various hot working techniques are used for its manufacture. The surface can be embellished by cold techniques after formation.

1) Hot shaping processes

Mouth blowing begins with gathering of molten glass that is collected at the end of a hollow pipe. The worker blows air into the pipe, either by mouth or with the help of a bellows. Shaping is accomplished with metal tools (e.g., shears or rods). Molten glass can also be blown to fill a metal, stone, or wooden mold. The two methods can be combined. A mold blown piece can be further shaped after it is removed from the mold.

Glass pressing is molten glass pressed into a mold with a metal tool. After the 19th century, this technology allowed for increased production, making glassware widely available.

Pressed and molded glass can sometimes be identified by mold lines, though these lines are often ground and polished away.

Core dipping or winding is a process by which a core of organic material (e.g., dung, straw) mounded over the end of a rod, coated with sand or clay, and dipped into molten glass or wrapped with rods of glass. The glass is continually heated and rolled over a smooth surface to produce a homogeneous surface. The core is removed after the glass has cooled.

Less common fabrication processes that may be encountered are pâte de verre, lost wax casting, and millefiore.

Pâte de verre, literally, is glass paste. It is produced by grinding glass to a powder, mixing it with an organic adhesive to enable the mixture to be molded or modeled, much like pottery. The conglomeration is fired, burning away the organic material, and fusing the glass powder together. The resulting glass body is more opaque than transparent.

Lost wax casting is essentially the same process for molten glass as it is for molten metal. A wax model is created, covered with clay, and fired to remove the wax. Molten glass is poured into the void left by the wax.

Millefiore glass is produced when rods of different colored glass are wrapped together with layers of colored glass and heated. The package is rolled on a textured surface that gives it shape while it is worked together. The thick rods are then cut into short lengths that exhibit floral designs in cross section.

Decorative detail can be added while the glass is still molten by fusing colored glass onto the surface of the object, or by integrating colored glass threads or shapes into the body and reheating.

2) Cold working techniques

Cold working techniques are used to create decoration after the bulk body has been formed. When glass is solidified, it can be fashioned using the same methods as in stoneworking. Among the techniques most frequently seen are the following:

Cutting or engraving into the glass with a rotating abrasive wheel, such as one with diamond chips, is a common method of decoration. Glass is removed from the surface to create the design.

Chipping is a less controlled and sometimes unpredictable method of removing glass from the surface to effect a pattern. The design can be directed by engraving the outline of the design, then chipping with a sharp tool to remove the glass.

Acid etching was first used in the 19th century to decorate glassware. The surface of the vessel was coated with wax into which the design was cut. The piece was dipped in hydrofluoric acid which etched the exposed glass.

In most cases, the final step in production is to polish away any signs of roughness or imperfections using a hard and very fine textured abrasive. High quality glassware is always polished while lower quality ware may show the evidence of manufacture, such as mold lines.

3) Flaws in manufacturing

It is important to know that some flaws that develop in the glass body during production are part of the manufacturing process and are not necessarily a sign of progressive deterioration.

Bubbles that appear in the glass are often intentionally added for decorative effect. Occasionally, misplaced air bubbles may develop during the molten state. A few isolated bubbles will not have any affect on the strength of the body, though a concentration in a single area may cause that area to be weakened. The shape of bubbles can give clues about the direction the object was worked while in the molten state.

Inclusions or foreign bodies are occasionally seen, though they are more noticeable in translucent bodies. These flecks may be from contamination in the crucible or impurities in the raw materials, such as metallic bits or sand. While small inclusions may disrupt the surface and look of the object, they will not affect its strength.

Progressive deterioration does occur when there are **compositional flaws** in manufacturing. This condition can be immediately apparent or may not be evident for many years. An unstable composition makes the glass body more subject to deterioration prompted by environmental cycling. The symptoms of deterioration are noted in Section C, "Agents of Deterioration."

Unstable glass was commonly made during a period of glass experimentation in the 17th and 18th centuries. In the course of a search for a substitute for colorless Venetian glass, insufficient amounts of lime stabilizer were added to the composition. This caused the alkali material (e.g., potassium or sodium) to leach out, creating voids in the body.

3. Materials and Manufacture of Stone

Throughout history, civilizations have used stone to record the facts of their lives, provide shelter, and give form to their creative

urges. It is the slow and often invisible deterioration of these stone sculptures, monuments, and buildings that park staff must prevent through appropriate conservation techniques.

a. Material Makeup and Structure

Geologically speaking, rock is classified into three broad categories based on the following formation conditions: igneous rocks form when magma cools and solidifies; sedimentary rocks form by the solidification or cementing together of sediments, both mineral and organic, from solution; and metamorphic rocks form by transformation from existing rock by pressure and heat, without melting.

These classifications are further subdivided according to mineral content, exact chemical composition, grain size, and texture. Igneous rocks (e.g., granite, basalt, obsidian, porphory) are generally hard and very stable because of their interlocked crystalline structure. Sedimentary rocks (e.g., sandstone, limestone, alabaster, travertine) composed of consolidated layers of disintegrated material are usually more permeable and exhibit a more rapid rate of deterioration than igneous rock. Limestone, a common building material is particularly pervious. Metamorphic rocks (e.g., marble, quartzite, slate, soapstone) have an altered crystalline structure depending on the parent rock. Marble is probably the most frequently encountered stone material in National Park Service collections. As a result of the metamorphosis of limestone, marble is formed of densely packed crystals having reduced pore space and size.

The durability of stone depends on its porosity, permeability, hardness, mineral content, and amount and type of inclusions. Porosity is the percentage of free space in a rock, and permeability is the capacity of a rock to allow fluids to pass through it. Degree of hardness can be measured using the Mohs Scale. This scale employs ten standard minerals of increasing hardness against which the unknown is compared. Hardness is assigned according to the numbered mineral which will scratch the unknown. Naturally, the harder the stone used in the production of the artifact, the less likely it will incur scratches or abrasions from handling or wind-born grit.

b. Production Processes

Stone working tools and techniques have changed little to the present day with the exception of electrically powered tools and cutting devices. Originally fashioned from stone, the basic cutting tools improved with the development of metals, especially steel, but the simple, proven shapes remained the same. Heavier and thicker tools are required for carving hard, igneous stones (e.g., granite) than those used for the limestones and marble.

Tempering, the process of hardening steel tools by heating, cooling, and slow warming, is also necessary for the tools used on hard stones.

Often, fine polishing has removed most traces of tool marks from the surface of a sculpture, but unviewed back surfaces or inaccessible undercuts are valuable for tracing the hand of the sculptor. Six basic tools are generally employed by the sculptor: point, tooth chisel, flat chisel, bushhammer, abrasives (tools or grits), and drill. While the carving tool is held lightly in one hand, the other hand wields a hammer or mallet which is used to strike the end of the point or chisel. The tool is guided by the thumb as it cuts through the stone by the force of the hammer's blow.

1) Traditional Carving Tools

Point (Punch)

After selecting a stone, the point is used for roughing-out the shape from the block. Large masses of stone can be removed with the point, progressing from larger to smaller diameter points. On rare occasions, an entire sculpture has been worked with only the point. In use, the point is held at an oblique angle to the stone surface and hit with a hammer.

Tooth Chisel (Claw Chisel)

Following the initial roughing-out with the point, the tooth chisel is used to remove more layers of stone while further defining the form. The carving progresses using a coarse chisel with well-spaced teeth and graduating to a fine chisel having numerous closely spaced teeth. While using the tooth chisel, sculptors carefully follow the contours of the form and the teeth marks will appear in several different directions. At this point the stone has a raked or combed appearance.

Bushhammer

While the tooth chisel is primarily used on limestones, sandstones, and marbles, the bushhammer replaces it when working on granite and hard igneous stones. The bushhammer, basically a series of points or teeth in one head (multi-pick), is useful for wearing down or pulverizing a hard stone surface. Similar to work with the tooth chisel, the sculptor progresses from coarser to finer toothed bushhammers. A stone worked with a bushhammer has a pitted, granular appearance.

Flat Chisel

The marks of the tooth chisel and bushhammer are usually removed with a flat chisel. In use, the flat chisel is held almost parallel to the surface of the stone as it cuts across

and removes material. A rounded edge to the flat chisel is useful for concave surfaces, otherwise a square, sharp cutting edge is employed. Although primarily a surface finishing tool for sandstones, limestones, and marble, the flat chisel may be used solely in the carving of some soft stones or when producing low relief carvings.

Abrasives

Once the sculpture is prepared with the flat chisel, final finishing and polishing proceeds. However, some finished sculptures may purposefully be left with a very textured surface. Rasps, rifflers, and files are examples of abrasive tools. As with wood and plaster, these tools are used to wear down the surface of the stone. Mineral and stone abrasives, in a finely ground state or as a solid block of material, are used primarily for cutting, smoothing, and polishing. Sandstone, pumice, and carborundum (silicon carbide) are used as abrasives, frequently for shaping and smoothing. Emery cloth, solid tin oxide, and sandpapers are used for finishing stone surfaces. Finally, whiting is used during polishing. Of course, use and order of these abrasives is interchangeable and the finishing can be stopped at any point by the sculptor.

Drill

The star drill is a metallic tool with a star head that is slowly revolved between the fingers while being struck with a hammer. A bow drill consists of a round headed tool held in a stationary handle with a rotating drum. The drum is rotated by either a bow and its cord wrapped around the drum or by another worker using a cord.

Stone splitting is accomplished by first drilling a series of holes along the line of the stone face to be split, inserting wedges into the holes, and hammering. A line of parallel vertical marks from the drill can be seen on the stone after splitting.

2) Ancient Tools and Techniques

Stone tools recovered from archeological sites were produced using flaking methods. Flint, obsidian, and chert were the favored stones because they flaked easily and gave a sharp edge when fractured.

There are two basic methods for detaching a flake: by percussion flaking, striking the core or parent block usually with or against another stone, or by pressure flaking, applying heavy pressure at a point with a stone, bone, or wood tool. The fracture face, known as conchoidal fracture, shows a series of concentric arcs radiating from the point of impact.

Additionally, a flake usually exhibits a bulb of percussion, or swelling below the point of impact due to compression.

Evidence of primary flaking, the initial roughing out, and secondary flaking, often seen as edge trimming, may be visible on ancient stone tools. Cutting, drilling, and abrading were also carried out using sand as the abrasive together with wood, bone, stone, or early metal tools.

3) Contemporary Techniques

As previously mentioned, contemporary sculptors employ the same basic tools that have been used by stone carvers throughout history. In addition, cutting techniques have been facilitated through the use of wire saws, diamond saws, and flame-cutting.

Pneumatic equipment basically decreases the time and lightens the labor of stone carving and is especially useful when working the hard, igneous stones such as granite. Compressed air is used to supply the force of the blow. The pneumatic drill or air hammer can be fitted with a number of chisels for delicate or rough carving.

4) Mechanical Processes

Pointing is a mechanical process for duplicating an original model into stone. A pointing machine, a movable instrument with adjustable rods, mechanically measures a number of points on the original and transfers these to the stone block. Holes are drilled into the stone corresponding to the point and depth measured with the pointing machine. The stone between the drilled holes is then chiseled away. Finer pointing is employed as the reproduction progresses.

Reducing from a larger model and enlarging from a smaller one can also be achieved with mechanical aids.

C. AGENTS OF DETERIORATION

By far, the greatest amount of damage to ceramics, glass, and stone results from mishandling and accidental breakage. While these inorganic materials have generally good chemical resistance, inherent chemical instabilities may exist that can make some ware vulnerable to heat or moisture.

1. Deterioration of Ceramics

Ceramics can be affected by lengthy and cyclic exposure to moisture and heat. Porous ceramics may be weakened when water is drawn into the body and dissolves salts or other organic matter. The migration of material leaves voids in the body and can push through to the surface. Glazes can develop the same degraded conditions as glass, such as crazing or crizzling, which leaves the surface with a cloudy appearance.

2. Deterioration of Glass

Glass is subject to corrosion by water. The following distinct conditions signal the irreversible deterioration of glass material: **crizzling, weeping, iridescence, efflorescence, and devitrification.** These related conditions involve the migration of components within the glass body to the surface that encourages the attack of water and subsequent deterioration of the chemical structure. Each state is part of the cycle of decomposition that progresses with fluctuations in relative humidity.

a. **Crizzling** is the very fine network of cracks that turns the glass from transparent to translucent. An unbalanced glass composition that has too little of the stabilizer lime (less than 4%), enables alkali components such as potassium or sodium to leach out. Hydrogen from atmospheric water replaces some of the missing alkali. The extensive loss of alkali can greatly weaken the glass structure.

b. **Weeping** is considered the wet stage of the deterioration cycle in which the leaching sodium or potassium combines with moisture. Sodium or potassium hydroxide is formed and accumulates on the surface of the glass. It often has a greasy feel and may be refered to as "sweating" glass. The condition can be compounded when the hydroxide continues to react with the atmosphere and forms very hygroscopic carbonates.

c. **Iridescence** is seen in the colorful layers that appear on the surface of glass. The phenomenon is actually due to a thin film interference, much like that seen in oil slicks. The layers are formed when the alkalis leach from the glass composition and combine with moisture. The strong chemical bond creates a permanent hygroscopic film that continues to attract water from the air. The hydrated alkali layer eventually separates from the

original surface exposing intact glass surfaces. As the cycle progresses, other layers begin to delaminate.

d. **Efflorescence**, in its extreme state, appears as a mass of fluffy white crystals on the surface. This is known to occur on glass trade beads sewn to leather skins. The beads weaken as the alkali components are attracted to the moisture on the surface, eventually breaking apart.

e. **Devitrification** occurs when the glass changes from the glassy to the crystalline state. It can be considered a flaw or with controlled production, an intentional effect. Intentional crystallization gives the glass good thermal shock resistance. Unintentional devitrification indicates an unbalanced glass composition, (too little alumina or too much calcium), or that the mixture cooled too slowly, or a combination of both conditions.

3. <u>Deterioration of Stone</u>

a. Outdoor Environment

The outdoor environment is generally much more aggressive to stone objects than an indoor one. Although the same types of degradation can occur indoors, the reaction times will be much slower and often more difficult to monitor. Therefore, deteriorating agents outside the museum are discussed first but it should be considered that a micro-environment inside the museum can induce similar damage to a stone.

1) <u>Water</u>

Water is the primary deteriorating agent of stone in the outdoor environment. Because water increases approximately 9% in volume upon freezing, yearly freeze-thaw cycles cause cracking, splitting, and spalling. Continual penetration of sedimentary rocks tends to cause separation of the layers. Soluble salts, such as chlorides, are carried into the stone by water and on drying can crystallize on the surface as efflorescence or below the surface and cause spalling or surface delamination. Water also acts as a solvent for pollutants from air or rain, discussed below.

2) <u>Atmospheric Pollutants</u>

Carbon dioxide reacts with water to form carbonic acid that dissolves calcium carbonate, the chief component of limestone and marble. Chlorides and nitrates hydrolyze to form hydrochloric and nitric acids, that are very corrosive to stone. Sulfur dioxide and sulfur trioxide, in the presence of water have a double aggressive action. They can hydrolyze to form sulfurous and sulfuric acids that attack calcium carbonate. Soot from burning hydrocarbons and free sulfur interact to convert carbonates into disfiguring brown or black

sulfate layers on the surface commonly referred to as "black crust." It has been calculated that urban rain dissolves an exposed surface of calcium carbonate at least fifty times faster than unpolluted rain, and can be as much as over one hundred times faster.[1]

3) Biological Agents

Algal, fungal, and moss growth on a stone's surface and inside cracks, retain water and contribute to the deleterious problems described above. The organic acid waste products from the alga-fungus metabolism dissolve calcium carbonate and can leave a marble surface badly pitted and susceptible to further attack. Micro-organisms also produce a variety of dark stains on stone. Disfigurement can also be caused by pigeons and other birds.

4) Windborne Materials

Soot, containing unburnt tarry particles, adheres to stone and discolors the surface. Wind driven sand, gravel, and particulates tend to remove deterioration products and weathering crusts from a stone's surface and contribute to its erosion.

5) Metallic Inclusions

Colored compounds can migrate into certain stones creating much disfigurement. This is especially problematic on sites where metals, such as commemorative plaques and reliefs or sculpture are mounted onto stone or used as interior stone supports. Copper corrosion products cause green stains and iron rust produces brown stains. In addition to staining, internally placed iron pins can cause a stone sculpture to crack by the added volume of rust. Some restoration solutions used on mounted metals can also stain the stone supports and bases.

b. Indoor Environment

1) Dirt

Because of wide variations in texture and surface finish, dirt tends to collect in localized areas as well as on horizontal planes of sculptures. The more traffic inside a museum and the less air filtration, the greater the accumulation of dirt!

2) Stains

Oils from repeated handling and previous restoration eventually crosslink and discolor with age and become especially noticeable on lighter stones. Adhesives and coatings such as shellac and wax darken over time and give the stone a blotchy appearance.

3) <u>People</u>

Museum visitors are probably the greatest agents of deterioration indoors, handling marks and breakage being the most obvious results. Graffiti, paint smears, and liquid attacks are more examples of deterioration caused by human contact. Inks, lipsticks, and paints can enter the pores of the stone and become very difficult to remove. Strong acids and bases will readily etch the surface and remove the polish.

4) <u>Water</u>

Water acts as a deteriorating agent indoors when the relative humidity is not controlled and enough moisture is present to react with salts, pollutants, or metallic inclusions to cause the various types of damage described above for outdoor settings.

5) <u>Change from Outdoor to Indoor Environment</u>

When exterior sculpture is moved into a museum environment, deterioration may be accelerated. Pollutants, biological matter, cleaning agents, and especially soluble salts, may leave residues within the stone that were once washed away by rain. In the new interior environment, large salt crystals may form on the sculpture. It may become covered with mold or metallic stains and it may even begin to spall.

D. PREVENTIVE CONSERVATION

1. Handling of Ceramics, Glass, and Stone Objects

Refer to Chapter 6 for general rules on handling museum objects. When moving objects, plan the most direct route possible with no stops along the way. Do not combine tasks. Make certain that the pathway is clear of potential hazards. When moving through public spaces, use an "advance" person to clear people or objects from the path. Frequent handling can be eliminated through the use of good quality photographs for each object. A complete set of both overall and detail photographs can provide much of the information that necessitates handling. Some specific rules that apply to the handling of ceramic, glass, and stone objects follow:

Ceramics and Glass:

a. Handle glass and ceramic objects as little as possible.

b. Before handling, examine the object carefully to note any unstable repairs, loose parts, lifting glaze, hairline cracks, or vulnerable appendages.

c. Do not wear cotton gloves to handle glass or ceramics because the surfaces are slippery. Remove jewelry such as rings, bracelets, and long necklaces that might scratch or chip the objects. Be sure hands are clean and dry before touching objects.

   Be careful not to touch with bare hands the surfaces of lustre ware, iridescent glasses (both intentionally treated and those with deterioration products), and gilded ceramics and glass. The moisture, oils, and acids left from fingerprints will disrupt and eventually etch these delicate surfaces. Use snug fitting latex gloves when handling these objects.

d. **Use both hands to support the object uniformly when moving it.** Do not lift by handles, knobs, rims, or decorative motifs. Never push an object to the side to gain access to another object.

e. Transport the objects in a padded basket or tray without crowding. When moving numerous or large objects, use a well balanced and padded cart.

f. Transport any detachable parts separately, such as lids or bases. If there are loose (but not removable) parts, slip tissue or padding between them to prevent rubbing or chattering.

g. Take care to place objects so they do not touch each other during transport. Use plenty of soft tissue or diapers around each piece to prevent them from rolling, tipping, or rubbing against each other. Do not move stacked glasses or plates.

h. Carry thin flat objects, such as securely attached mirrors or panes of glass, in a vertical position in order to distribute the strain of the weight and to minimize the possibility of cracking. The use of a dolly or hand truck is acceptable if it has soft plastic or rubber wheels and the surfaces are adequately cushioned. Plastic or rubber wheels and cushioned surfaces serve to reduce shock and vibrations from bumps in the floor.

i. Never apply cellophane tape or sticky labels to ceramic or glass objects. Delicate overglazes, decals, and gilding are especially sensitive. Do not remove any labels that are already attached.

Stone Objects:

a. Hands should be clean and clean white gloves worn as well.

b. Always be careful where hands are placed: paint, gold leaf, and delicately carved areas are easily knocked off; previously repaired areas may not be as stable as the undamaged stone.

c. Size and weight may be deceiving. Always carry one item at a time and never lift by any projecting parts such as arms, legs, or wings.

d. A cart should be used when moving an object for more than a very short distance or when moving more than one object. Have a supply of protective pads, wedges, or blankets to stabilize objects on carts and to prevent them from abrading each other.

e. If large numbers of small stone objects are continuously being moved at the same time, carts and trays should have built in padded dividers or molded separators. Placement in polyethylene bags or museum specimen trays will also eliminate edge damage and scratching during movement of small stone objects.

f. Large and heavy sculptures may require a forklift. Sufficient personnel must be available to secure a sculpture on a pallet that is being lifted.

   If straps or chains must be temporarily wrapped around the sculpture, make sure they are well padded and cannot slip off the pads to scratch or mark the stone surface. Again, be especially aware of projecting parts when lifting a sculpture by hoist.

g. Know where you are going and where you plan to put an object before lifting.

h. Careless handling of ladders, scaffolding, maintenance equipment, and paint can cause irreparable damage to stone sculpture.

2. <u>Environment for Ceramic, Glass, and Stone Objects</u>

To the extent possible, materials that respond to temperature and humidity in a similar manner should be stored and exhibited together. Regardless of how durable an object appears to be, all environmental conditions should be equally stable. Every effort must be made to ensure that the temperature and humidity are maintained within a fairly narrow range. Ideally, fluctuations should not exceed ±3% relative humidity in a month. Any inevitable fluctuations (e.g., daily or seasonal) should be controlled as much as possible.

Recommended levels for relative humidity and temperature are noted below. In those climates where these levels may be difficult to maintain, environmental ranges must be established on an individual basis.

a. Low-fire ceramics and stone can be considered together when planning their storage and exhibition. These materials, if in stable and unadulterated condition, present relatively few problems when compared to more sensitive organic materials. A stable interior environment, appropriate for staff or visitors and relatively free from atmospheric pollutants is acceptable. Recommended environmental levels for storage of low-fire ceramics and stone are as follows:

Temperature range:	55-75°F
Relative Humidity range:	40-60%

It is important to keep the relative humidity below 65% to avoid mold growth.

b. High-fire ceramics and glass have similar physical characteristics and will react to the environment in a comparable manner. These materials are more crystalline in structure and do not accept environmental changes as easily as more porous material. In addition, objects that appear to be sturdy can be deceiving. Potential instability is often difficult to detect readily. Initial stages of deterioration are accelerated by high temperature and humidity levels, and are exacerbated by cycles of change. For these reasons, the storage environment must be maintained in more narrow ranges than for low-fire ware. Recommended environmental levels for storage of stable high-fire ceramics and glass are as follows:

Temperature range:	45-55°F
Relative Humidity range:	45-55%

c. Glass objects that show deterioration, such as weeping, cloudiness, or iridescence, or that are suspected of being unstable, should be separated from the collections to await a conservator's examination and treatment. It is essential that these objects be stored in a firmly controlled environment, such as a conditioned vitrine or museum specimen cabinet. Recommended

environmental levels for storage of unstable high-fire ceramics and glass are as follows:

Temperature:	maintained at 62°F (±2°)
Relative humidity:	40% (±3%) (Higher RH causes the salts to solubilize and migrate. Lower RH will cause cracking).

d. Stone artifacts framed in wood should have the same environment acceptable for wood. Refer to Appendix N for acceptable environmental levels for wooden objects. Otherwise, dimensional change in the wood caused by fluctuations in relative humidity and temperature could produce cracks in the stone. If there is polychrome on stone, continual or rapid changes in relative humidity can cause the paint to become brittle, crack, and eventually flake off.

e. Light levels do not present a problem unless there are polychrome stone sculptures or ceramics in the collection, in which case light levels should not exceed 50 lux. The ultraviolet radiation component should be filtered.

3. Storage of Ceramic, Glass, and Stone Objects

From a preservation standpoint, collections that can be stored according to their sensitivity to the environment are at an advantage. **The primary objective in the storage of brittle objects (e.g., glass and ceramics) is to minimize handling, thus the potential of breakage.** Design the storage area so that access is safe, simple, and direct. Refer to Chapter 7 for guidance on the storage of museum objects.

Glass and Ceramics:

a. The storage area should be in a low traffic part of the site, away from public access.

b. Store ceramics and glass on stationary shelving units. Shelving units are safer for ceramics and glass than movable drawers. The shelves should be lined with a non-slip material such as Volara® sheets (closed cell polyethylene foam) that is firmly attached so it will not bubble up or slide out. Refer to Section J of this appendix for a source for Volara®.

c. Closed museum cabinets with clear glass doors allow visual inspection of the contents without handling. (Refer to the NPS Tools of the Trade for information on these cabinets.) Units with doors containing gaskets and smooth-working mechanisms will minimize dust accumulations.

d. The shelves should be only deep enough to accommodate a single object to discourage the need to move objects to retrieve others.

Place small objects in rows with ample space around them for ease in handling.

e. Store the heaviest objects on the lowest shelves.

f. If at all possible, do not stack plates, cups, or bowls. If it is necessary due to a critical lack of space, place generous sized sheets of soft fabric (e.g., cotton flannel) or thin polyethylene foam between each object. Make sure the objects nest well (e.g., as matching dinnerware) and do not put any pressure on each other. Do not overstack.

g. Objects that are unsteady due to damage or that are top-heavy should be stored in the most stable configuration possible with the help of padding or cut foam blocks. Refer to Figure P.1 for an illustration of a technique for stabilizing objects in storage.

h. Shelves should not be so high as to require the use of a stepladder.

i. Open shelving units should have a close-fitting dust barrier over the front, such as continuous clear polyethylene sheeting or fabric. If oversized objects must be stored in the open, they should be individually wrapped or bagged to protect them from dust.

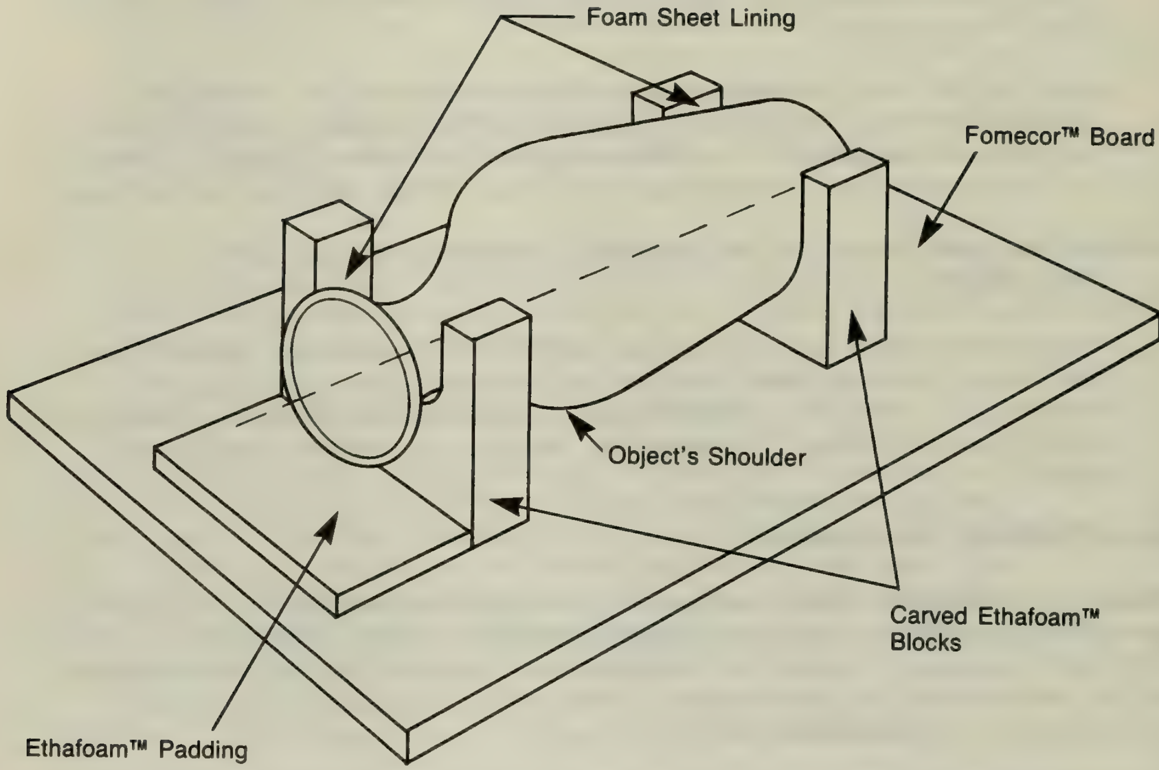
Unstable Glass and Ceramics:

Chemically unstable glass and ceramics must be stored in a closed, space that provides constant temperature and relative humidity. An airtight container such as a fishtank with plate glass across the top can be maintained at approximately 40% relative humidity by using silica gel or a saturated salt solution.

Silica gel- Place oven dried silica gel at the bottom of the tank along with a hygrometer to measure the relative humidity. Mist water over the silica gel until the RH registers about 40%.

Saturated salt solution- A saturated salt solution made from zinc nitrate crystals (Refer to Section J Source List) and water will maintain an atmosphere of 42% RH at 68°F. When an excess of crystals is added to water and will no longer dissolve, the solution is considered to be saturated. This solution is placed in the bottom of the tank.

With either method the object needs to be placed above the bottom of the container. Support the object on a sturdy, stable, perforated plastic platform over the silica gel or salt solution. A dial hygrometer or RH indicator strip should be placed in the tank to monitor the humidity level. To ensure that the tank is airtight, petroleum jelly must be applied over the rim of the tank before the plate glass is laid across the top.



A top heavy or damaged object can be stored in a Ethafoam™ cradle.

Lay the object on its side, supported so it is level. Measure the curve of the base and the neck with a flexible drafting curve. Cut each curve into a 1″ – 2″ thick Ethafoam™ block. Use a long knife (e.g., bread knife) with a fine serrated edge. Thickness depends on the size of the object.

The placement of the curve on the block should allow the shoulder of the object to touch, not rest heavily, on the mat.

Padding or a thickness of Ethafoam™ should be placed underneath any projecting part of the object (such as the rim) as a barrier against bumping.

Cut thin foam sheet for lining the cradle surfaces.

The foam blocks can be free standing or fixed to a Fomecor™ board so that each cradle is portable.

Figure P.1. Method of Stabilizing Objects in Storage

Stone:

a. Dirt and dust can accumulate within the pores of stone and darken the surface. Whenever possible, keep the stone covered to avoid unnecessary dust accumulation. In storage, polyethylene sheeting or bags can be lightly placed over stone objects for protection from falling dust and debris.

b. Placement of objects near open windows, air conditioning vents, or heat sources should be avoided.

c. Small stone objects such as arrowheads or beads may be stored in drawers or trays on shelving units. Padded dividers will prevent the small items from slipping onto each other and possibly causing scratches or breaks when a drawer is opened or the tray lifted. Standard plastic or wooden boxes with dividers are also useful for small items. A cover of tissue or polyethylene sheeting will protect an open tray from dust. Ideally, drawers or dedicated trays should be lined with a stable foam; such products are, Volara®, an expanded, closed-cell polyethylene foam which has been cross linked or Ethafoam®, an expanded, closed-cell polyethylene foam. Individual shapes are then cut in the foam liners to accommodate the specific object. Accession information can be written directly on the foam in a standard location around the object's cut-out. These lined drawers are also useful for study purposes, since it is likely that the object will be returned to its proper housing.

d. Because of their size and weight, large stone objects such as reliefs, busts, and statuary present problems. Well supported metal shelving is necessary to accept the weight of the stone objects. Shelves should be lined with a non-compressible material such as carpet pads or stable, closed-cell polyethylene foam. <u>Do not use polyurethane (ester or ether variety) foams</u> because aged polyurethane foams disintegrate and crumble on the stone.

e. Store heavier objects on lower shelves to lower the center of gravity and minimize the danger of a rack toppling over.

f. Do not allow parts of an object to protrude beyond the edge of shelving where they might get bumped.

g. Avoid storing a sculpture directly on the floor where it can be kicked and marred or subjected to floor maintenance materials.

h. A low deck in one area of the storage space is ideal for keeping sculptures off the floor.

i. Sufficient space should be maintained between objects to prevent accidental bumping and to enable periodic inspection. Overcrowding of these large objects must be avoided to prevent conditions conducive to accidents. Pedestals and pallets can also be used for storing statuary.

j. If a heavy piece is likely to be moved within a short period of time, it is useful to store it directly on a dolly to minimize excess handling.

k. A number of measures can be taken to safeguard collections in storage from total loss during an earthquake. Shelves and cabinets should be securely bolted to walls and floors. Restraining bars and elastic strips attached to the edges of shelves will prevent objects from flying off the shelf and toppling over. Overhead lights, pipes, and ductwork should also have reinforcing attachments to the ceiling[2].

4. Exhibition of Ceramics, Glass, and Stone Objects

a. Glass and ceramics on exhibition should be securely mounted so that if the case or pedestal is bumped, they will not be knocked over readily. Acceptable mounts include freestanding or wall mounted metal wire brackets or stands made from clear plastic sheet (e.g., Plexiglas®). Mounts must be padded where the metal touches the object. Flexible plastic tubing or felt over the ends of the wire will prevent scratches.

b. Light in exhibit cases should be cast evenly. Do not direct spotlights on individual objects. Spotlighting can induce thermal shock as well as raise the temperature of the case.

c. Because of size and relative stability, statuary is usually exhibited without a case or vitrine and is vulnerable to touching, vandalism, and breakage. Therefore, it is necessary to provide a physical barrier or separator between visitor and object. Individual pedestals or a continuous deck to accommodate a number of sculptures are useful. The pedestal should be sufficiently high or significantly larger than the object so it cannot be easily climbed on in an attempt to reach the work of art.

d. Busts and smaller stone objects must be securely mounted to prevent pushing or toppling over. These techniques can include: a dowel from the object into the pedestal, a niche in the pedestal to contain the base of the object, and straps or other added armature for fastening the object to a supporting structure. A padded separator should be used between the stone and any metallic support to avoid scratching or abrasion of the surface. Metal clips should be checked periodically to ensure that they have not bent and are adequately supporting the mounted stone object. Mounting height should prevent easy access to delicately carved areas or tempting projecting appendages.

Stone reliefs should not be plastered directly into the wall for two reasons: difficulty of later removal and transferral of rising damp or soluble material directly from the walls into the stone. Similarly, cement bedding is not recommended due to the large quantity of water in the cement that will be sucked into the

stone carrying with it soluble alkalis. The water can also activate salts inside the stone which formerly may not have been of consequence. A damp proof membrane (e.g., lead, bitumen, Teflon®) is necessary to protect a stone sculpture that is placed on a concrete pedestal or floor, or when placed in direct contact with an outside wall. The membrane serves to protect the object from water soluble contaminants that may be present in the concrete.

e. Stone objects on exhibition should be kept free of dust. One should never use a cloth for dry cleaning as this might rub the dirt into the surface. Only use a soft brush. Dust can be swept directly into a vacuum cleaner or collected by vacuum cleaner immediately afterward.

f. Exterior stone sculpture and monuments are not exhibited in an ideal environment and therefore should be carefully monitored for alterations. By conducting an annual condition survey of the work of art, and comparing the present state with detailed photographs, the park curator should be able to pinpoint problematic areas and any detrimental changes to the stone. In unusually corrosive environments, the stone should be brought inside and a replica placed outdoors.[3]

g. It is important to consider potential seismic activity in the area when designing mounting systems for stone artifacts, standing sculpture, in particular. A sculpture can be protected from horizontal displacement during an earthquake by mounting it on an isolation base which allows the floor to move while the object in essence stands still. Ball bearings and centering devices enable the base to move within a specific radius without transferring a dynamic load onto the sculpture. Foam with high shock absorbancy can be used to protect a mounted sculpture from vertical movement.[4]

E. CARE OF COMPOSITE CERAMIC AND GLASS OBJECTS

Composite ceramic and glass objects found in park collections include mirrors, chandeliers, and mounted objects. Examine each object closely. It is essential to identify its different materials (e.g., glass/ceramic and metal, wood, gilding) as well as its method of assembly (e.g., where are the movable parts, what areas bear the weight, and how is the object installed) in order to plan appropriate handling and storage.

1. Framed Mirrors

a. Inspection

Inspect the mirror to see how solidly it is attached to the frame. Check the condition of the frame. Are the frame sections securely joined? Are the decorative motifs and gilding well intact? What parts are safe to handle when lifting the mirror? Is the mounting or hanging method adequate?

Examine the mirror carefully. Are there any breaks or chips in the glass? Is the glass sticky or does it have an overall network of very fine cracks (which means that it is deteriorating)? Is the coating on the back still reflective or are there black spots and streaks that indicate that it is deteriorating or peeling?

Look closely through the front of the glass to see if any silver colored droplets or beads have formed on the back of the glass. Before the 19th century, mirrors were made reflective with a mercury/tin amalgam. This coating can break down and return to the liquid state. Droplets may collect at the bottom of the frame. Be extremely careful if the reflective coating appears to be unstable. Check the immediate area for any loose mercury droplets. Wear disposable latex gloves when handling mirrors. Store the mirror separately from the rest of the collection. Contact a conservator to thoroughly examine an unstable mirror.

b. Storage and Exhibition

The ideal method to store framed mirrors is face up on well-padded shelves. Make sure that the weight of the object is not resting on a few pieces of hardware (e.g., screw eyes) or on the glass. Alleviate some of the weight of the frame from the glass by supporting the edges of the frame with padding. Heavy mirrors should be stored flat.

To hang a mirror for exhibition (or if it must be stored in a hanging position), be sure that the glass is very well attached to the frame and that the hanging device is sufficient to carry the weight of the piece. When hanging a small mirror by braided picture wire, use two picture hooks rather than one so that the weight on the wire is evenly distributed (See Appendix L: Curatorial Care of Paintings, Figure L.1.).

Heavy mirrors need more substantial support. A flush mount system of interlocking beveled wooden or metal slats will bear more weight than picture wire. One slat is attached across the back of the mirror and the corresponding slat is attached to the wall. Refer to Figure P.2 for an illustration of a flush mount for hanging heavy mirrors.

c. Cleaning

Gilded surfaces can be dusted with a soft artist's brush (see Source List in Section J) if the gilding is intact. Cleaning should be performed by a professional conservator. The glass face of a mirror in good condition can be cleaned with a water dampened cloth if necessary. Lay the mirror on a pad on the floor or a sturdy table. Before wiping the front of the glass, make sure that the back of the glass is fully supported. Keep the damp cloth well away from the frame so moisture will not be drawn underneath. Dry the glass with a soft cloth.

2. Chandeliers

a. Inspection

Each chandelier should be thoroughly examined to get a clear idea of which parts are fixed and which are free to move: how secure are the hooks and joins? and are there any missing prisms or parts? Overall and detailed black and white photographs should be taken to record where each piece is attached.

b. Storage

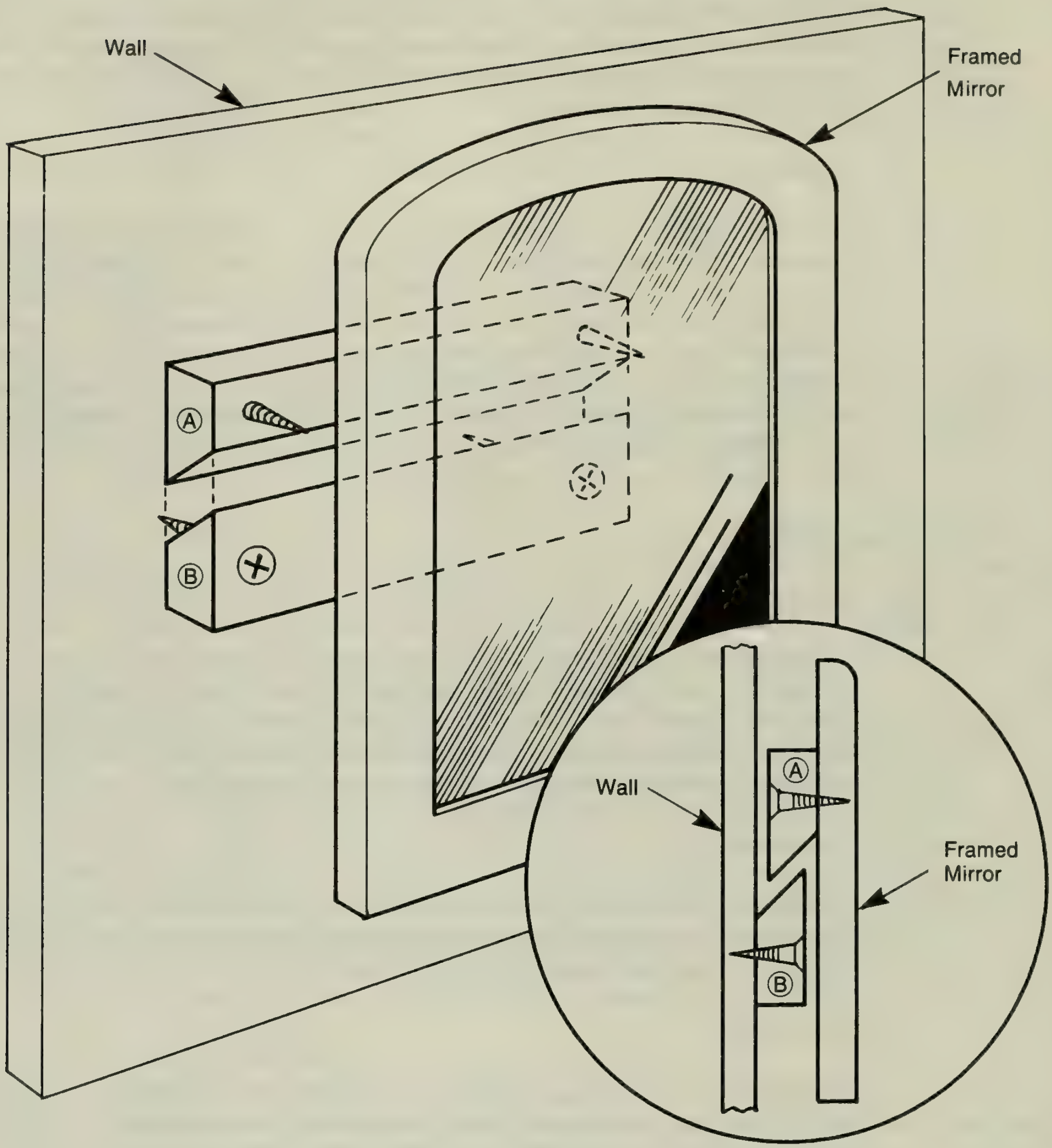
During periods when a chandelier is not actively on view or is in storage, it should be cleaned then and covered with a fabric or plastic bag to keep it dust free.

c. Cleaning

Chandeliers on view should be dusted periodically to prevent dust build-up and the need for comprehensive cleaning. When cleaning in situ, use a scaffold so that there is enough room to manuver and both hands are free. Steady each prism or movable part while dusting so that they do not bump into one another. A professional conservator should be consulted if more extensive cleaning is necessary.

3. Mounted Glass and Ceramics

Examine mounted objects to see how securely the mounts are held to the glass or ceramic. Ormolu (gilded metal) mounts are often made up of several interlocking parts, which may loosen and rub against the



Place the mirror face down on a padded surface. Use additional padding in the flat and recessed areas to relieve any pressure on ornately carved areas.

Measure the width across the back of the frame, approximately one-third down from the top.

Locate a point on each side of the frame back into which the mounting board can be safely attached.

Cut a rectangular clear pine board (e.g. 1″ thick × 4″ wide, though the actual dimensions depend upon the size and weight of the mirror) to the width of the frame back. Cut the board along the grain at a 45° angle to the edge. Paint all wood surfaces with one coat of two-component epoxy paint.

Screw Part Ⓐ into the back of the frame and Part Ⓑ into the wall.

Figure P.2. Flush Mount for Hanging Heavy Mirrors

ceramic. Glass and ceramic objects that are combined with other materials such as metal, wood, or stone should never be cleaned with aqueous solutions. Water can seep between the mount and the object. Consult a conservator about cleaning these materials. Exhibited objects should be dusted as needed. Objects in storage should be kept as dust-free as possible.

F. CERAMIC, GLASS, AND STONE OBJECT CONSERVATION ISSUES

The following discussion provides an idea of some of the treatment issues in ceramic, glass, and stone conservation. Treatments should be carried out by a conservator or in some instances, such as washing, by other individuals trained or supervised by a conservator. These issues are briefly discussed in this section in general with no specific guidelines, in order to acquaint the park curatorial staff with the problems and to assist them in evaluating a conservator's treatment proposal.

1. Cleaning

Certain straightforward treatment such as surface cleaning can be carried out by curatorial staff trained or supervised by a conservator.

To avoid large cleaning projects in the future, both exhibited and stored objects should be dusted periodically. If the collection is stored in a relatively dust and traffic-free environment, then dusting as needed will suffice. Do not dust in situ. The dust will not be removed, merely moved around and it is more likely that damage will occur. Move the objects to a separate area to be dusted. A workspace should be prepared by covering a table or countertop with mattress padding. Move only as many objects to the workspace as can be safely dealt with at one time. There should be ample room for the objects.

a. Ceramic and Glass Objects

There are few reasons to wash pottery or glass objects. A program of routine washing is discouraged. Often, careful dusting will remove much dirt and grime. First-hand instruction from a trained conservator will help prevent damage. There are several dangers of indiscriminate cleaning. The immersion of ceramics or glass in water can shock the structure of unstable objects. Conditions such as invisible hairline cracks, delaminating glazes, or leaching components may be provoked. Low-fire wares can be weakened when the soluble components in the body (e.g., salts or dirt) swell, migrate, and finally break through the surface, causing the glaze to spall.

Before considering a wet treatment, be certain that the conservator has determined that:

- the ceramic body is actually fired;
- the body is fired sufficiently and is intact;
- the surfaces are actually glazed (or glass) and there are no painted plaster repairs (see next paragraph);
- all repaired areas are secure;
- the glazed or glass surfaces are not powdery, sticky, or crackled;
- there are no existing stains that might migrate or increase.

If any of these conditions cannot be met, then wet cleaning is not recommended.

Repaired areas can be detected by several means:

- A small magnifying glass used in good daylight is a convenient tool for examining surfaces of objects.
- A hand-held ultraviolet lamp will readily identify cracked glaze, nonceramic fills, adhesive lines, or painted surfaces. Surface anomolies will fluoresce different colors or not at all. Paint, plaster, and adhesive will not fluoresce; shellac will fluoresce orange.
- Test the different colored glazes in inconspicuous areas with damp cotton swabs to confirm that they are truly glazed.

b. Stone Objects

Before wet treatment, at least one test cleaning spot should be conducted in an inconspicuous area. Poultices or packs help ensure that stains are carried above and not deposited on the surface of the stone. Use of steam may enhance many of the wet treatments. If marbles require soaking (e.g., to remove soluble salts) it is preferable to use water saturated with calcium carbonate (e.g., water with marble chips). This step will eliminate any possibility of calcium carbonate leaching from the object into the water.

CAUTION: Do not clean with acids. Be aware that most commercial stone cleaners contain an acid component. Sandblasting is not recommended for cleaning stone. It can result in heavy loss of material from stone surfaces. A blasted surface may weather more rapidly because of the roughness or micro cracks induced.

Note on cleaning alabaster: Alabaster (calcium sulfate) is readily attacked by water. The polish on alabaster can be removed with one wash in water. Organic solvents can be used to remove dirt and grease.

2. Repair

Small broken glass, ceramic, and stone objects can be repaired with a variety of adhesives. Beyond a certain weight or when the structural integrity of the object is questioned, adhesives based on polyester (stone only) or epoxy resins are required. Although epoxies and polyesters are generally considered nonreversible or very dificult to remove, in these instances there is no alternative. The curator and conservator should discuss the disposition of the stone object and together select the appropriate method of repair. Polyester adhesives are made in a number of stone color choices and a range of viscosities. A thin layer of an acrylic resin used along the edges of an epoxy or polyester join may assist future attempts to reverse the repair. After dissolving the acrylic, a strong solvent or solvent

mixture can be introduced to break down the epoxy or polyester adhesive. A combination of solvent and mechanical action is usually required to reverse a polyester or epoxy join.

If broken pieces require an internal dowel for support, a non-corroding metal such as stainless steel (coated brass is also acceptable) must be used. As noted earlier, iron dowels can oxidize and cause staining or cracking on expansion. When dowelling is necessary, any original stone removed should be carefully saved and labelled for future research. A conservator will only remove original material from artifacts as a last resort.

3. <u>Removal of Old Repairs/Disassembly of Sculpture</u>

Old repairs can often have large overpainted areas which have discolored. Removal of the unknown materials is often extremely time consuming as it is unlikely that reversible products were utilized. Today conservators confine inpainting to the loss area only, using carefully selected materials, tested for their longevity and reversibility.

Disassembling a sculpture is a major effort and requires much consultation between curator and conservator. Usually such a radical treatment is only undertaken if a restoration is unsightly or deceptive, or original parts are discovered.

4. <u>Consolidation of Stone</u>

When a stone object lacks cohesion, is particulary fragile, or has loose polychrome, consolidation may be required.

Methods for effective consolidation of stone are hotly debated among stone conservators. The ideal consolidant would protect the stone from physical and chemical decay and at the same time strengthen an already deteriorated one. Outdoor stones and those brought inside from a previous exterior environment may require consolidation of a spalling surface or deep cracking. Some of the more frequently used consolidants include: lime water (saturated solution of calcium hydroxide), alkoxysilanes, silicone resins, acrylic resins, and barium hydroxide. These materials can be toxic or carcinogenic.

Because of the difficulties in finding the ideal consolidant, some conservators are now suggesting the use of a protectant which will literally protect the surface of the stone, avoiding the questions and problems of penetration. A protectant is a temporary surface coating and requires periodic renewals depending on the aggressiveness of the environment.

G. PACKING AND SHIPPING GLASS, CERAMIC AND STONE OBJECTS

Refer to Chapter 6 for general guidance on packing and shipping objects. Packing specifications for glass, ceramic, and stone objects are discussed in terms of relative size. All are fragile and should be packed in double crates, the inner box being floated in the outer crate with foam. For temporary purposes, such as shipping and packing, foams not acceptable for long term storage, including polyurethanes (polyesters) and polystyrenes (styrofoam), can be used. Polystyrene pellets (styrofoam "peanuts") should not be used for supporting objects inside a container because they can settle and subsequently cause loss of protection for the object.

1. Shipping Container

Shipping containers should be constructed of a least 3/8" thick plywood with wood battens for edge reinforcement. Additional cross battens should be placed on all large faces of the crate. A polyethylene liner will provide a moisture barrier. Lids should be sealed with a gasket and secured to the crate with captive screws.

2. Shipping Container's Interior

a. Small Objects

Small objects should be packed in an inner box constructed of plywood with appropriate reinforcement. This inner box can be a true six-sided box or a stack of trays. When using trays, the top-most one must have a lid. Objects should be packed within the inner box or tray in contoured foam. (Ethafoam® is easier to cut than styrofoam and does not produce the same residues.) The foam may be cut roughly to shape and the gaps filled with tissue to save labor. Avoid pressure on any fragile projections of the object.

Multiple objects can be packed in a single inner box, however, each object must be separated from the others by having an individually contoured niche cut in the foam, or, in the case of lightweight objects, its own small box. Objects should be isolated from the foam with soft tissue. Acid-free tissue is not necessary. Some tissues buffered with powdered calcium carbonate may be slightly abrasive to gilded ceramics or painted objects. Cotton flannel may be used. Objects with extremely delicate surfaces and appendages (e.g., painted ceramics or Santos figures) require special attention. In order to prevent loss of body or decoration, long strips of soft tissue should be closely wrapped around the object. Unsupported areas should be loosely fitted with soft tissue prior to overall wrapping. Refer to Figure P.3 for technique for wrapping fragile objects.

1. Object with a fragile or delicate surface.

2. Wrapping Technique
   a. Cut soft tissue (does not have to be acid free) into long strips.
   b. Carefully wrap tissue strips around the object.
   c. Tape ends to tissue only.
   d. Repeat wrapping until object is completely covered with a few layers of tissue.

Figure P.3. Technique for Wrapping a Fragile Object

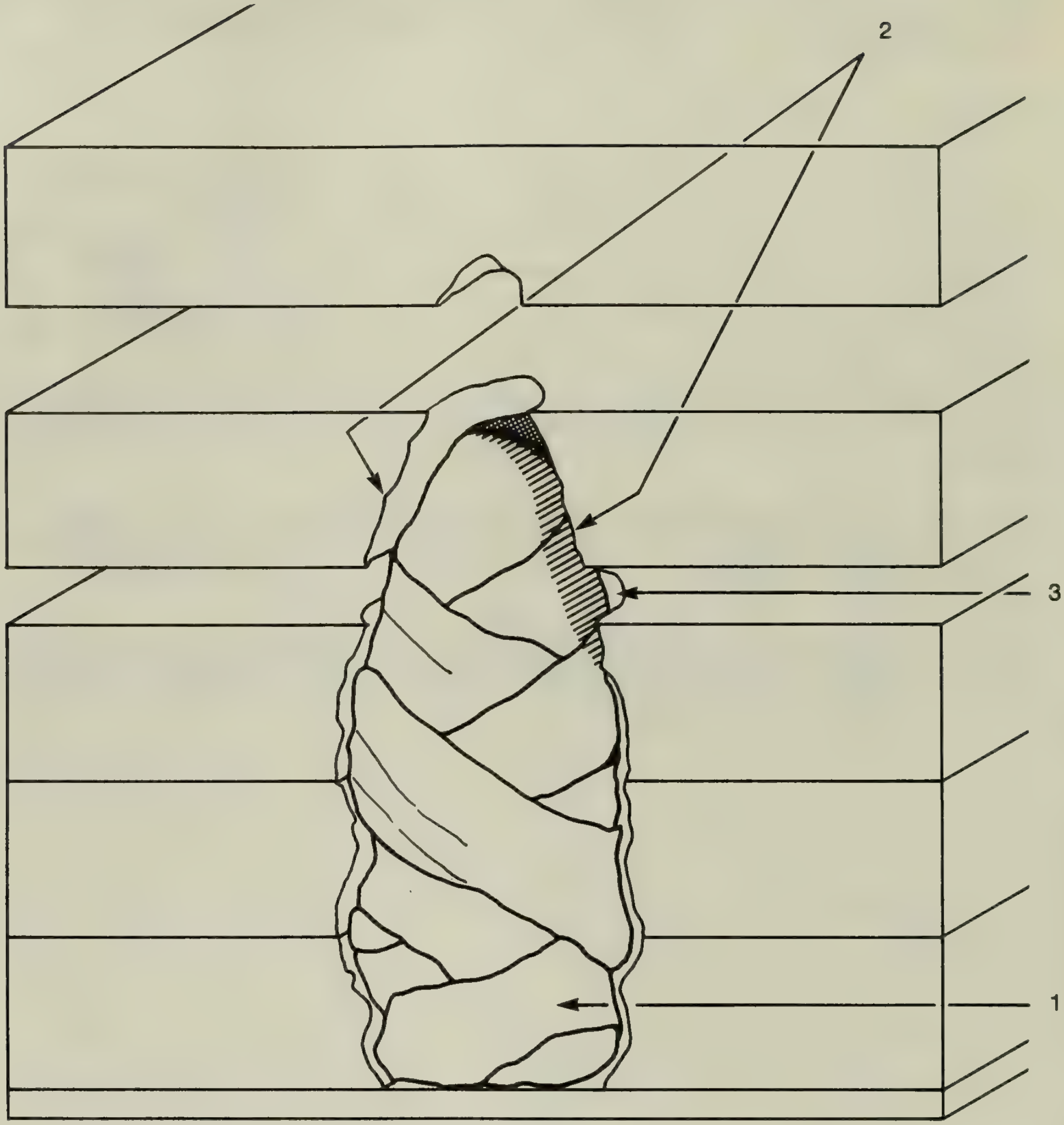
Fragile sculptures, or those with large flat surfaces, should be packed in layered foam cut to the profile of the object. The object should be first wrapped in tissue. Refer to Figure P.4 for an illustration of the technique for layered foam packing for fragile objects.

b. Large Objects/Sculpture

Large objects and sculpture usually require individual shipping containers with interior supports at weight bearing and stabilizing locations. Braces should be padded and the object may require tissue wrapping at brace-to-sculpture contact points. Some medium-size sculpture of very solid construction may not require double crating. In this case, the object should rest on a padded plywood base which is floated on a foam layer of appropriate density between the object support and the bottom layer of the crate. Ethafoam® is recommended for use with heavy objects.

Some of the containers may require multiple faces that can be removed from the base. Crate faces should be secured with bolts or heavy captive screws.

Forklift height and distance between tines should be taken into consideration when designing and constructing shipping containers.



1. Fragile object that has been enclosed in mummy wrapping. The tissue wrapping protects the object's surface from abrasion that may be caused by the foam packing material.

2. Cut layers of Ethafoam™ to completely fill the interior dimensions of the foam lined crate. Use a long knife (e.g., bread knife) with a fine serrated edge. The stack of foam is then cut in half vertically. Next, the contours of the object are cut in each half of the foam stack, one layer at a time. Nest the object in the center of the layers.

3. Fill any gaps in the foam's center with tissue paper. *Caution:* Do not put pressure on the object.

   This technique works best when the top and front of the crate are removable.

Figure P.4. Layered Foam Packing for Fragile Objects

H. EMERGENCY PROCEDURES FOR CERAMIC, GLASS, AND STONE OBJECTS

Refer to Chapter 10 for guidance on emergency planning and to Chapter 8 for general rules on appropriate response to emergency situations involving museum objects. When the emergency affects artifacts, but does not endanger personnel, refer to the following section. During an emergency, it is essential to use common sense and handle the museum objects carefully.

1. Water

It is best to protect the objects from water leaks by covering them with plastic sheets or bags. A little water may not be harmful, but uneven wetting can cause mineral migration in stone (resulting in stains) as well as streaking through surface grime layers that can be difficult to correct. Painted pieces, unfired clay, or deteriorated stone and glass would suffer greater damage from water. The plastic should not be completely sealed as this would stimulate mold growth.

Raise objects off the floor onto blocks or skids if rising water is a problem. Have "dry areas" designated for object removal in cases where an entire floor or storeroom is flooding.

2. Fire

Remember, not only fire, but also smoke and water used in fire fighting can damage the artifact. These inorganic materials do not burn, but if a fire rages for a long enough period of time they can char, causing surfaces to blacken in appearance.

Plastic sheeting should not be used to protect objects during a fire. Polyester sheet such as Mylar® which has a very high melting point can be used (time-permitting) to protect the works from water and chemicals used in fighting fires.

3. Severe Weather/Bomb Attack

These emergencies could result in toppled and broken objects and sculptures, shattered cases, and flying glass.

Move objects away from windows. Cover glass cases or tape cases to avoid shattering and flying glass. Lay vertical objects on to their sides on floors or benches. If an object is attached to a base, it must be supported along its length so that it is horizontal. This action prevents unnecessary stress from being placed at the join between the object and its base.

Identify objects in the collection that should be evacuated first in situations where the viability of the structure is questioned.

4. Liquid Attack (e.g., acids, bases, solvents)

Vandals may throw or spill a liquid onto artifacts exhibited without vitrines or cases. Act quickly and avoid contact with the unknown liquid, such as sulfuric acid, lye, gasoline, which, in many cases, may be harmful to personnel.

Small, localized attacks should be rinsed well with water. Water should neutralize acids or bases and slow severe etching of the surface. Large objects, attacked overall, will have to be rinsed with copious amounts of water.

It is best to consult a conservator to ensure that the object has been adequately treated.

5. Broken Object

Cordon off the area and photograph the object in situ. If possible, do not touch anything until conservator arrives. If pieces must be moved, carefully collect all fragments, bag, label, and keep with the object until they can be turned over to a conservator.

If breakage does occur, count and save all the fragments and as many chips as possible. Handle the pieces as little as possible. Any dirt, dust, or abraded surfaces will impede a successful repair. Each fragment should be stored separately in a small individual box or a clear plastic bag which is labeled. Fragments can be stored in a padded tray and should be placed well apart from each other so they do not rub together. If the pieces must be transported, wrap each piece in soft tissue and identify with a label.

I. SELECTED BIBLIOGRAPHY

Glass

Armitage, E. Liddall
1959 Stained Glass. History, Technology and Practice. Newton, MA: Charles T. Branford Co.

Brill, Robert H.
1978 "The Use of Equilibrated Silica Gel for the Protection of Glass with incipient Crizzling," The Journal of Glass Studies, v. 20, pp. 100-118.

Newman, Harold
1977 An Illustrated Dictionary of Glass. London: Thames and Hudson.

Newton, Roy and Davison, Sandra
1989 Conservation of Glass. Boston, MA: Butterworths.

Phillips, Phoebe (ed.)
1981 The Encyclopedia of Glass. New York: Crown Publisher, Inc.

Ceramics

Hamer, Frank and Janet
1986 The Potter's Dictionary of Materials and Techniques. 2nd ed. London: A & C Black.

Larney, Judith
1975 Restoring Ceramics. London: Barrie and Jenkins.

Rhodes, Daniel
1973 Clay and Glazes for the Potter. Rev. ed. Radnor, Pa: Chilton Book Co.

Rhodes, Daniel
1959 Stoneware and Porcelain. Philadelphia: Chilton Book Co.

Stone

Amoroso, G. G. and Fassina, V.
1983 Stone Decay and Conservation, Materials, Science Monographs, 11, Elsevier.

Fifth International Congress on Deterioration and Conservation of Stone,
1985 Lausanne. Various papers.

Hempel, K. F. B.
1968 "Notes on the Conservation of Sculpture, Stone, Marble and Terracotta, Studies in Conservation, 13, 34-44.

Rich, Jack C.
1947 The Materials and Methods of Sculpture. New York: Oxford University Press.

Sneyers, R. V. and de Henau, P. J.
1968 "Conservation of Stone," in The Conservation of Cultural Property, Museums and Monuments XI, UNESCO.

Stambolov, T.
1970 "Conservation of Stone," Conservation of Stone and Wooden Objects, Preprints of the Contributions to the New York Conference, I.I.C., 119-123.

Torraca, G.
1981 Porous Building Materials, International Center for the Study of the Preservation and the Restoration of Cultural Property, ICCROM.

Winkler, E. M.
1975 Stone: Properties, Durability in Man's Environment. Second Edition. Springer-Verlag.

J. SOURCE LIST

Refer to the NPS Tools of the Trade for information about sources for supplies. A list of special supplies is as follows:

Closed cell polyethylene foam lining - (e.g., Volara®). This material is available from:

Voltek, Inc.
100 Shepard Street
Laurence, MA 01843
Phone: 617/685-2557

Also sold under the name "Nalgene" by other companies, that is repackaged Volara®.

Zinc nitrate crystals- $Zn(NO_3)_2\ 6H_2O$. Available from: Fisher Scientific.

Artist's brushes for dusting- a natural hair brush such as camel's hair are relatively inexpensive and are available in a variety of sizes. Brushes for wet cleaning- both natural hair or synthetic bristle brushes are appropriate. The bristles should be stiff enough to loosen soil but soft enough not to scratch the surface of the ceramic. For both uses, wrap tape around the metal ferrule to prevent scratching the object. Available from local art supply stores.

K. ENDNOTES

1. Thompson, G. and White, R., "The pH of Rain and the Destruction of Alkaline Stone," Stone in Conservation, v. 19, (1974) 190-191.

2. Hensley, John R., "Safeguarding Museum Collections from the Effects of Earthquakes," Curator, Volume 30, September 1987, pp. 199-205. New York: American Museum of Natural History.

3. The marble David by Michelangelo originally situated outside the Academie in Florence was brought inside and replaced with a replica.

4. An isolation base was developed and manufactured by Jack Yaghoubian, president of Quantech Systems, Sherman Oaks, California, for a large marble Kouros at the Getty Museum. A description of the base is included in, Jerry C. Podany, "Advances in the reassembly of large stone sculpture at the J. Paul Getty Museum, "Recent Advances in the Conservation and Analysis of Artifacts, London (1987) p. 380.

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

☆ U.S. GOVERNMENT PRINTING OFFICE : 1991 O - 289-594 : QL 3